THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXI. No. 1830.] LONDON, JUNE 7, 1898. [50TH YEAR. PRICE 6d.

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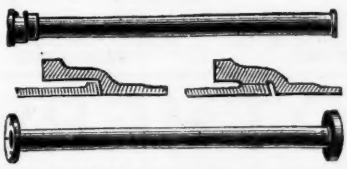
1¼ to 12 IN. BORE.



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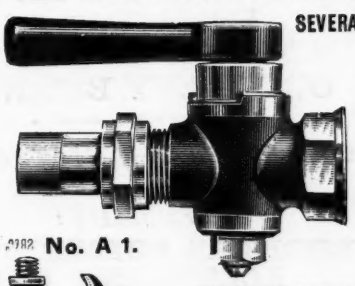

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FULL-WAY

AS SHOWN.

SUPERIOR QUALITY AND FINISH IN GUN METAL.

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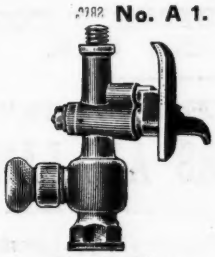

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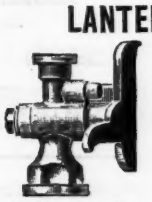

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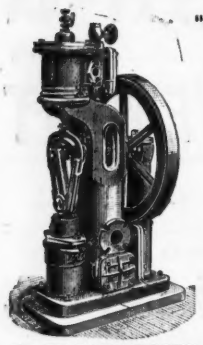

Fig. 705. "SINGLE RAM" STEAM-PUMP.

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

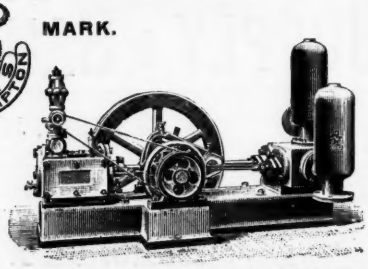

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

Fig. 712 "DOUBLE-RAM" STEAM-PUMP.

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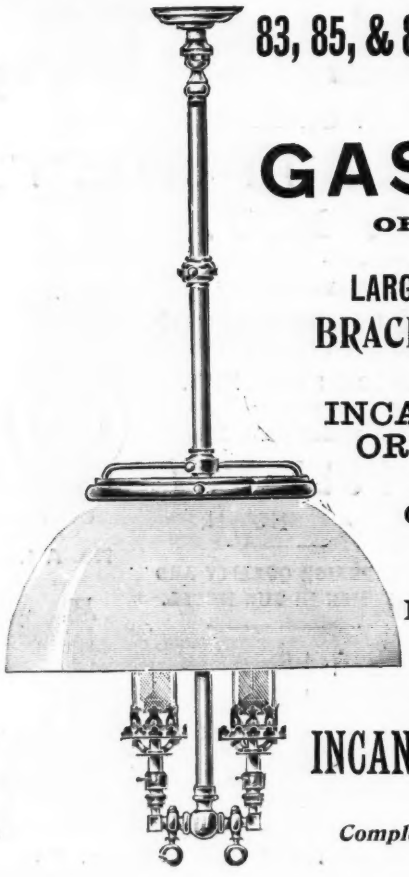

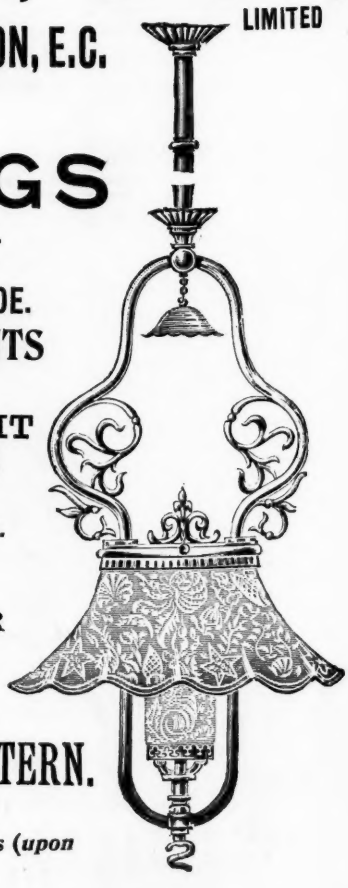

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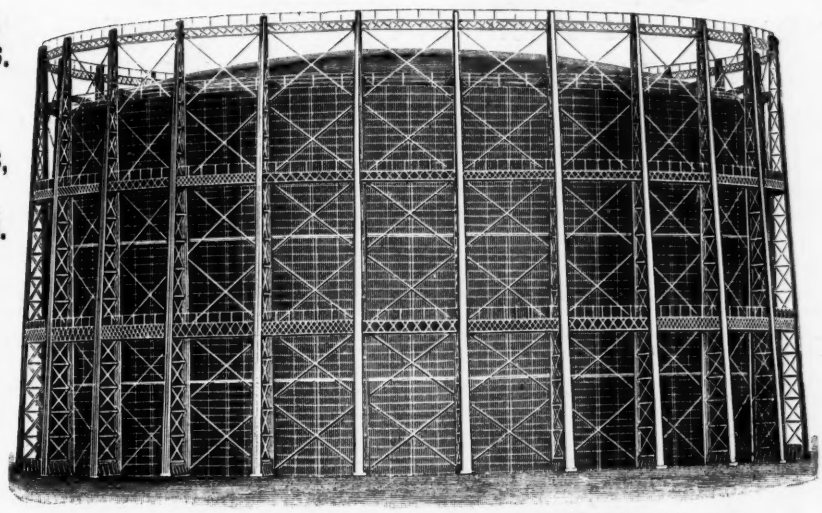

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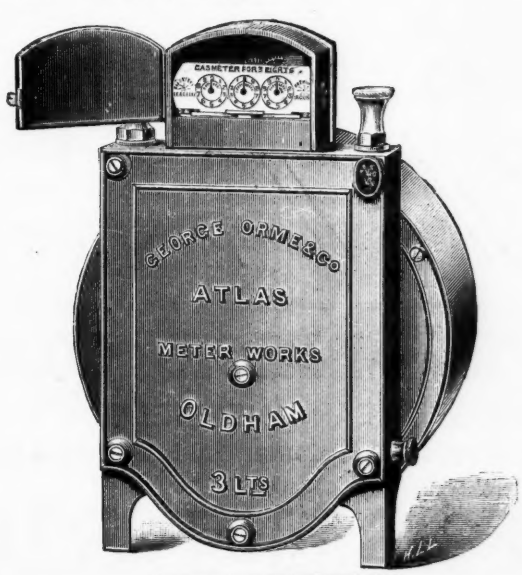

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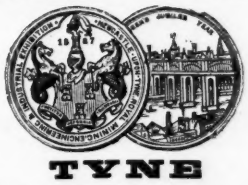

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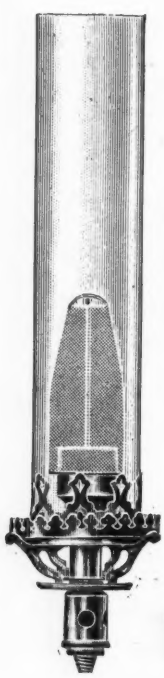

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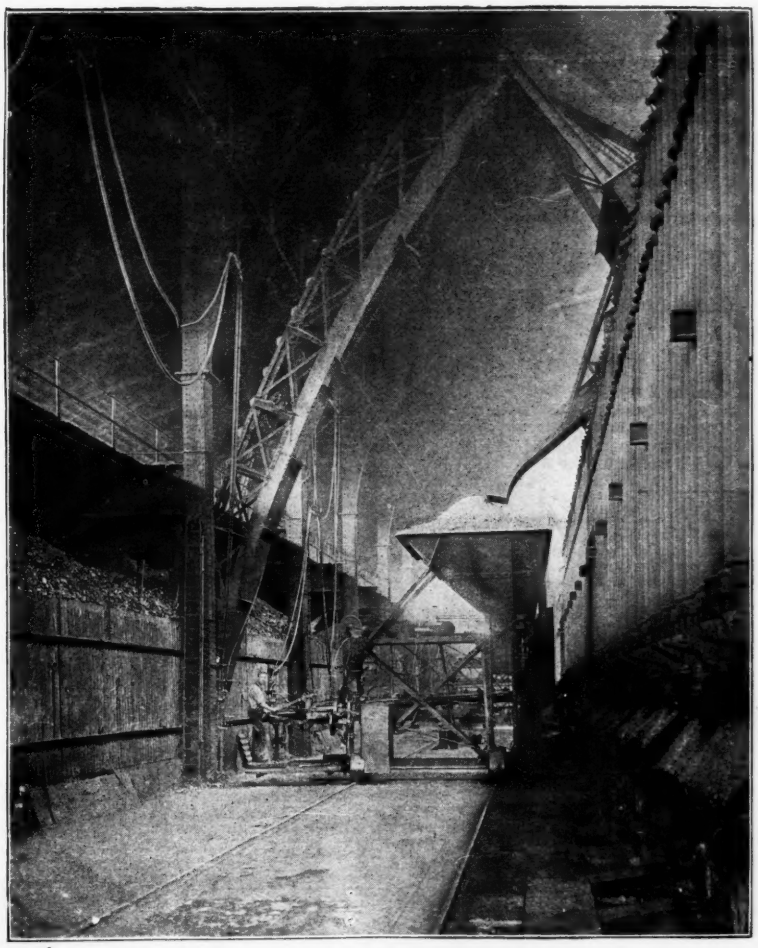

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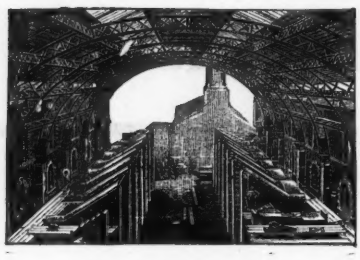

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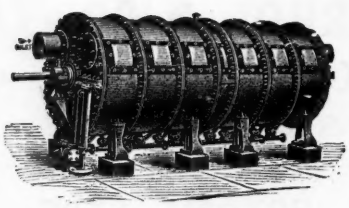

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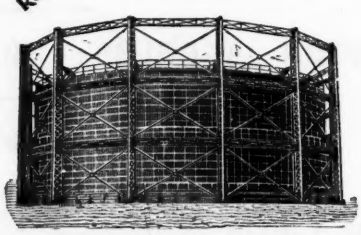

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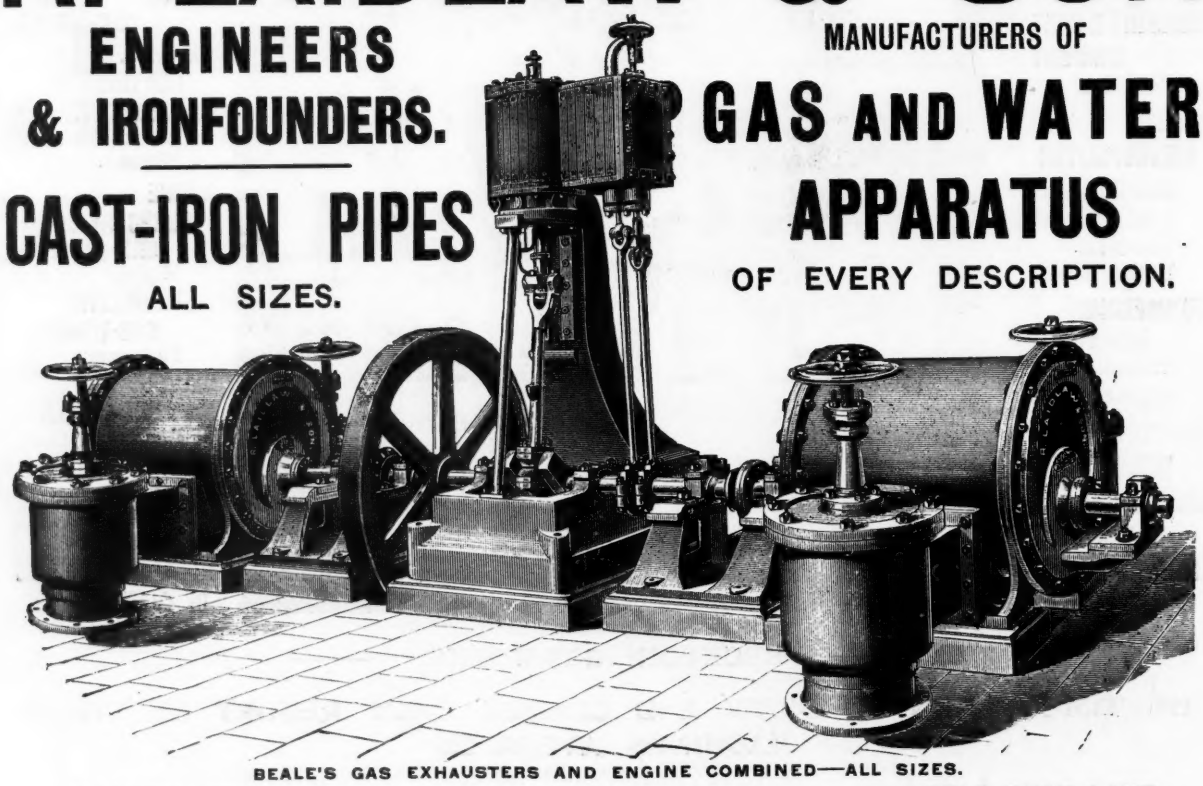

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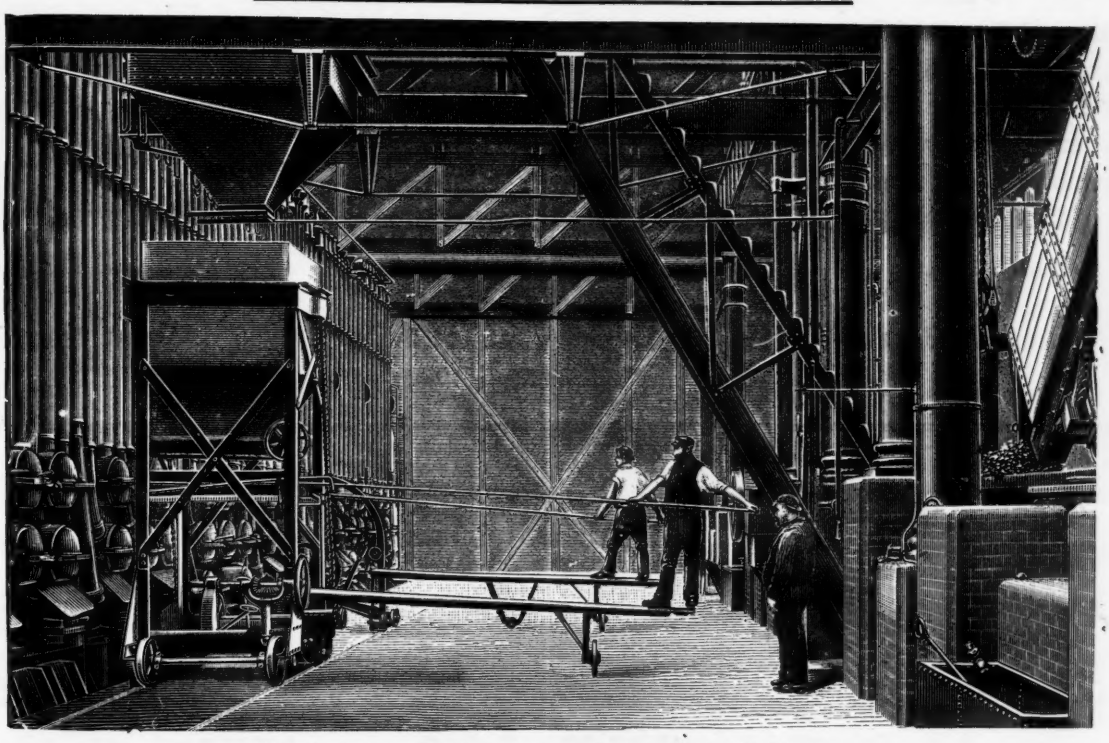

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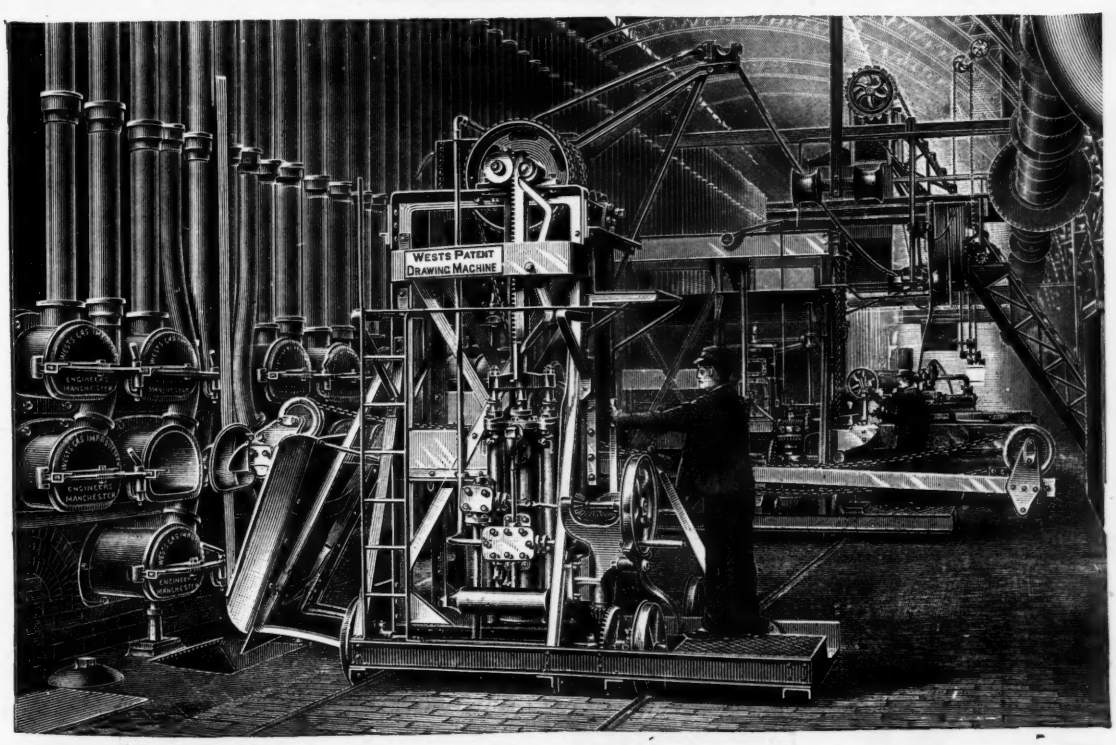

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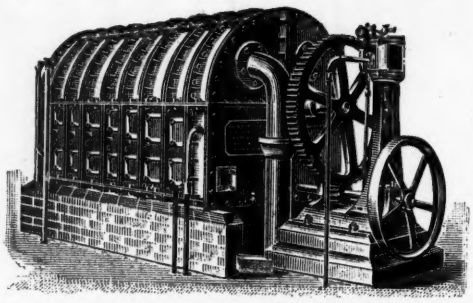

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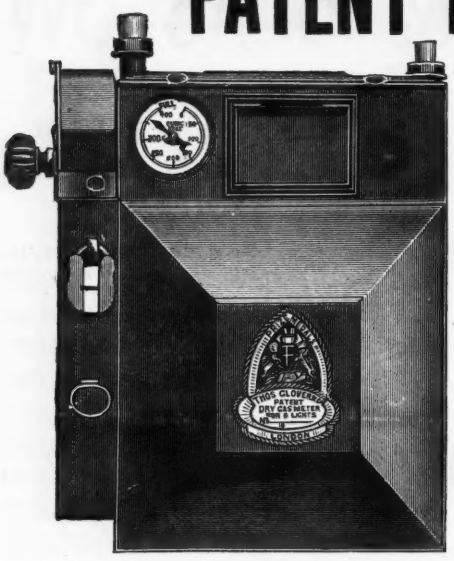

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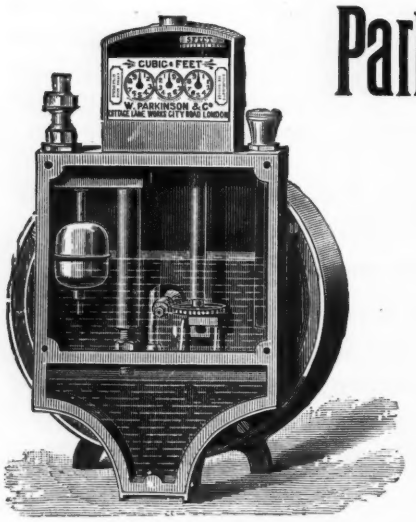

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EDITORIAL NOTES.

The Cost of Workmen's Compensation.

THE letter of Mr. Thomas A. Guyatt, and the other matter bearing upon the subject of workmen's compensation, which we publish to-day, deserve to be regarded together as tending to clear the ground around this novel and difficult subject. The first point to come out from this addition to the available stock of premonition as to what is likely to happen after the Act comes into operation, is the warning that those employers who contemplate acquiring protection by outside insurance will do well to "see that "they get it." This consideration has been magnified by the discussions that have arisen over the rates of insurance proposed by the Associated Offices. When the rate made by these offices for gas workers was first disclosed, the immediate effect created was that of unpleasant surprise. Gas managers could not understand why the offices wanted to charge 25s. per cent. of the wages paid to gas workers, for insurance under the Act, when all previous experience went to show that the "waste" of this particular section of the army of industry could be well provided against at a considerably lower cost. Since the question was first raised, however, more particular inquiry has had the invariable result of supporting the position of the Associated Offices. We do not go so far as to say that this position has been altogether justified, but only that the evidence, such as it is, lends countenance to the growing opinion that the insurance experts "know their book." So far as the controversy on the question of the rate has gone, it has borne out the tenor of our essay of the 17th ult.

It is instructive to look at the question as illustrating the difference between the Associated and Outside Insurance Offices. As is only natural, the ordinary insurer fumes and rages against the "monopoly" of the Tariff Offices; but in his heart he knows that there is one thing of even greater importance in insurance than the rate—and that is the certainty of getting the sum insured paid within a reasonable time after tendering claim and proof of loss. With a good office, there is no trouble on this score. If an insurer elects to go outside, he can doubtless effect an immediate saving; but not a little of the difference of expenditure is really an additional risk—the insurance of the Insurance Company itself. Take for evidence on this head some of the statements of a special article published in the "Daily News" of Friday last. The article deals with fire insurance; but the principle involved is the same. "Practically, all the Companies of London are in com-"bination. . . . . Attempts have been made from "time to time to break down the ring by starting inde-"pendent Companies; but . . . . one of two things "has always happened. Either the resources of the "independent Company have been exhausted in the "struggle, and the enterprise has collapsed, or if it has "succeeded sufficiently to become formidable and trouble-"some it has been lured into the ring, and gone the way "of all the rest." That is to say, the "underseller"—who is not peculiar to one trade—either breaks, or he lives to see the unwisdom of working for less than it is possible to get; and he reforms and becomes one of the respectable majority. This is not the whole truth of the matter, though it is a large part of it. Sometimes the underseller—as in the classical example of the inroad of the "Stores" upon the retail shopkeepers—has reason on his side; and then he prevails. The great point to be observed is that there must be some sufficient reason for any successful revolt against the ordinary course of a trade by an underseller. The reason may be good, in the ethical sense, or bad. It may consist in the abolition of the incubus of unlimited credit, as in the "Stores" case; or it may be traceable to some systematic sharp practice or unfair dealing. All trade is, in a sense, speculation; but underselling is gambling. Gamblers do not always lose; but they must take their chance.

We also publish the text of Mr. George Livesey's report upon the first six months' working of the South Metropolitan Gas Company's accident fund. This is positive information of the highest value. It goes to show that, where special provision is made on a liberal scale to meet cases of accident, the men who have a right to these benefits are disposed to claim the utmost they can get. Here, in a nutshell, is the difference between the existing state of things in factories and that which will prevail

on and after the 1st prox. Men will claim what they call their rights, without sparing those upon whom the claims come. It is necessary to utter a word of caution concerning Mr. Livesey's interpretation of the reservation for "contributory negligence" contained in the Act. He says that under the Act "no compensation is payable for "accidents caused by the injured man's gross negligence." The Act says that the workman shall be compensated unless the employer can show that the injury is attributable to the "serious *and* wilful misconduct" of the workman. As Mr. Showell Rogers has pointed out, in a letter to "The Times," these words open up a vista of prospective legislation. At any rate, it is hazardous to paraphrase them. The more the risks under the new law are looked into, the more serious they appear, in the absence of pertinent statistics covering a sufficiently long period of time. We are informed by Mr. Livesey that the South Metropolitan Gas Company paid in wages last half year as near as may be £160,000, and consequently the £559 actually disbursed as compensation for all accidents, inclusive of pensions for widows, was just 7s. per cent. of the wages-bill. This works out to about $\frac{1}{40}$d. per 1000 cubic feet of gas sold. Hence Mr. Livesey concludes, on the basis of these figures, that, under a continuance of the same conditions, 5s. per cent. would provide amply for everything prescribed by the Act, while 10s. per cent. of the wages in gas-works would cover all accidents and pensions on the more liberal scales recognized by the South Metropolitan Company.

Correction for Temperature in Gas Distribution.

THE Committee of the Institution of Gas Engineers appointed in 1896 to inquire into the influence of temperature upon the measurement of gas by consumers' meters have reported; and their report, which appears in another column, will be considered at the coming meeting of the Institution. The inquiry was placed in the hands of a Sub-Committee consisting of Messrs. Colson, Hunt, Frank Livesey, and R. O. Paterson, who undertook to ascertain the facts in regard to the distribution of gas in their respective districts. These particulars have been put together in an agreed form, and reduced to diagrammatic presentments which exhibit at a glance the agreement and differences of the records for the various districts. The practical question is: What are the lessons to be drawn from this information? The inquiry was undertaken by the Institution as a result of the reading of two papers at the 1896 meeting, by Mr. G. Livesey and Mr. W. Fiddes, which raised the question of whether or not gas undertakings should correct for temperature their returns of gas made and sold. The discussions upon these papers revealed the existence of many different opinions on this head, all based upon reasonable considerations resulting from individual observation of the actual facts. Some gas managers did not correct for temperature; others corrected to an arbitrary standard of 60° Fahr.; and some endeavoured to apply the correction with regard to observed temperatures.

The most obvious point of the inquiry of the Sub-Committee is to show that there is no advantage in correcting to 60°, if the object is to obtain a reliable comparison between the volume of gas made and that measured by the consumers' meters. This practice "only tends to "increase fictitiously the quantity of so-called leakage or "unaccounted-for gas." When the point is considered, it will be seen that there is no sound reason for correcting to a standard temperature of 60°, or any other arbitrary figure. The practice has grown out of the corresponding rule for correcting for atmospheric temperature and pressure in photometrical experiments. But the latter is a necessity of physical science, which only recognizes a permanent gas as being itself, to all intents and purposes, when it is of the standard density. A foot length of any material susceptible of linear measurement is only a foot when it is exactly 12 inches long. Gas is only gas, to the physicist, when it is measured at 60° Fahr. and 30 inches barometrical pressure. There is no similarity between the purposes for which this correction is made in the physical laboratory, and those which the gas manager has in view when he thinks of correcting the registrations of his station meter and the consumers' meters. The word is the same; but the thing intended, or required, is quite different. The employment of correction to 60° in the latter case is merely parodying the laboratory rule.

As a matter of fact, the temperature of gas when measured by the consumers' meters varies through a range corresponding roughly with the atmospheric temperature. It sometimes rises above that temperature during the hottest weeks of the year, but never descends quite so low. The Cheltenham diagram is the most enlightening, showing as it does on the same scale the temperature traces of the station meter, the air, and five gas-distribution districts. Here, as also in Birmingham and in Leicester, the temperatures of the gas at the consumers' meters and of the air are fairly uniform throughout the greater part of the year—except during December and January, when the gas is from 5° to 10° warmer. The difference between the records of several districts for this season, in the same town, perhaps means that where there is the briskest consumption the gas has less time to cool. Of course, the gas is warmer than the air to start with; and the Cheltenham diagram shows that at the station meter the gas is, as a rule, about 10° warmer than it is at the same time at the consumers' meters. Perhaps at the meeting the members of the Sub-Committee will explain what would be the effect of correction for temperature, as suggested by their own diagrams, upon their returns for unaccounted-for gas for the time being.

A Commendation of the Sliding-Scale.

IT is worthy of notice that the Joint Committee of both Houses of Parliament who have had to consider the new schemes for generating and distributing electrical power in bulk from large central stations, not necessarily situated within the districts they are intended to supply, came to the conclusion that it would be desirable to introduce the sliding-scale of dividends and prices into this class of undertakings. Moreover, the adoption of this means of regulating the finances of the undertakings is proposed as being specially expedient in the interest of the consumer, and as a substitute for the compulsory power of purchase by the Local Authority which is the leading principle of existing electricity-supply legislation. Thus it appears that, in the estimation of Parliament and of the Board of Trade, the principle of the Gas Companies' sliding-scale is by no means so inefficient as Mr. Pickersgill would have the House of Commons believe. A technical contemporary, however, lately ventured to characterize the recommendation of the Joint Committee in this regard as only a "sop to public sentiment." The views expressed in respect to this enactment are peculiar. We read: "It is pretty extensively believed that little good has "been got from such provisions hitherto in the case of "Gas and Water Companies. They certainly do not "make for economy of management and direction, but "rather, when things are flourishing, for such large Boards "and numerous officials that almost every considerable "shareholder has a chance of a seat on one or a nomina-"tion of the other. And then when times are not quite so "good, retrenchment becomes exceedingly difficult." It is impossible to make head or tail of this passage; and one can only conclude from it that the writer had not the smallest inkling of what the Gas Companies' sliding-scale is, or of how it works. The remark about directorships and officials is particularly tenebrous. Fortunately, the criticism is not worth serious notice; but it is a curious illustration of the weakness of some of our modern would-be specialistic journalism, which is not specialistic at all.

The Report of the Inspector of Alkali, &c., Works.

THE thirty-fourth annual report on Alkali, &c., Works has just been issued by the Chief Inspector, Mr. R. Forbes Carpenter, and is packed, as usual, with matter of high technical interest. The total number of works now registered under the Acts is 1183. Both number of works and of processes under inspection show slight variations from the last report. The number of separate gas liquor works remains the same as in 1896; but of sulphate and muriate of ammonia works the number is the same as in 1895—an additional establishment existing in 1896 having now dropped out. In describing the prosecutions undertaken in accordance with the Acts, the Chief Inspector discusses at length the case of the Commercial Gas Company, which, he says, ended in an amicable settlement that yielded the Department the precedent it sought. The point is a highly important one in connection with the working of sulphate plant. The ex-Chief Inspector, Mr. Alfred E. Fletcher, had decided that "the time had arrived when "the method of combustion of the sulphuretted hydrogen

"evolved in the manufacture of salts of ammonia from "gas liquor, and of its subsequent discharge into the "air as sulphurous acid, could not, for works of large "size, in the light of the experience that had been gained "since 1882, be considered as a satisfactory fulfilment "of the obligations enjoined by the Act of 1881." It was a question of what were "the best practicable means" for preventing the discharge into the atmosphere of noxious gases. Mr. Fletcher had been in communication with the Commercial Gas Company with regard to the steps to be taken for dealing with the sulphuretted hydrogen from the Stepney station, and had suggested that the gas should be utilized in the manufacture of vitriol. The suggestion was acted upon, and proved successful. Thereupon the Company decided to treat the Poplar works in the same way; but in the meanwhile the Poplar chimney was continuing the discharge of the burnt gas in the old-fashioned way. Mr. Forbes Carpenter thought this should be prevented; and he put before the Company the method successfully used for some years by the Oldbury Alkali Company "of neutralizing the acid escape by passing the gases "up a tower filled with limestone and fed with a flush "of water." The Company accepted the proposition; but progress with the erection of the necessary apparatus was slow, and steps were taken against the Company for the recovery of penalties under clause 9. Before the case came on, however, some further progress was made; and ultimately the Company satisfied the Court with a guarantee in consideration of which the case was removed from the list. As already stated, the Department regard this "automatic settlement" as giving them the precedent which they desired for dealing with other works on the same lines. Further particulars are given in the report respecting the experimental working of oxide of iron purifiers in connection with sulphate of ammonia plant, with concurrent revivification by regulated steam and air admission. Mention is made of a method proposed as an alternative to oxide of iron purification where the output is too small to make the Claus process available. The constitution of ammoniacal liquors, the statistics as to ammonia production, and the recovery of products from coke-ovens, are touched upon by the Chief Inspector. The District Inspectors' reports, which cannot be further noticed on the present occasion, are valuable contributions to the technology of their subjects.

Dr. Creighton on Co-operative Industry.

A REMARKABLE discourse on some of the aspects of modern life and labour was delivered at the recent Co-operative Congress by Dr. Creighton, Bishop of London. Among other things, the Bishop said: "Man, if he called himself "intelligent, must ever strive to understand the details "of his own life, and to feel that he could to some "extent control them." This effort after the realization of personality is being made in some respects a great deal more difficult by the world's progress. We still scarcely appreciate the enormous magnitude of the problem which the industrial revolution of the early part of this century brought forward for solution. The introduction of machinery necessitates the factory system and the conduct of business on a large scale. "While it made employment "uncertain, the workman's position was entirely changed "in this respect, which is more important than all others, "that he no longer could understand the conditions of his "life or what affected them. He might be better educated; "he might seem to be more independent when he had no "relation to his employer save that of a money payment. "But he had sunk from being an intelligent to being an "unintelligent man; for this reason—he could no longer "know, and he could no longer affect, the conditions that "regulated his employment." Hence the workman is prone to discontent. He has become a "hand," and is not consulted in regard to the plans of the brain of the industry. Men no longer understand the entire process of the industry at which they labour. "The nature of the "markets, the causes which determine the value of their "labour, the methods and the utility of production—all "these are beyond their ken." Consequently, there has arisen a set of agitators who tell the workman that he need not trouble himself about these matters, which are out of sight. The only thing that the workman sees is his own labour; and this, he is told, is the only source of value and spring of profit. Co-operative enterprise is a corrective of this mistake.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1335.)

THE Stock Markets reopened on Tuesday after the Whitsuntide holiday in a rather languid mood; and all through the week business continued to be quiet. The ruling tendency, however, was decidedly good—general business being the characteristic in pretty well every department, and prices at the close showing a nice advance upon the opening figures. The entire absence of any trustworthy intelligence respecting the progress of the war kept speculation quiet; but the cheapness of money promoted activity in good investment stocks. The Bank of England lowered its rate by another ½ per cent. on Thursday—a measure which had been generally anticipated; indeed, many thought that the Directors need not have made two bites at the cherry, but might have made one drop from 4 to 3 per cent. the preceding week. Business in Gas stocks was rather more active on the whole; and the tendency was firm and good. Changes in quotation are few; but they are all in the upward direction, with one exception only, which is the result of special circumstances. Gaslight "A" was the most conspicuous in both strength and activity. It hesitated a little at first; and on Wednesday changed hands at 295. But next day it jumped up to 301; and though the closing figures were not quite so good, yet the quotation had gained five points. The secured issues were quite neglected; only a couple of transactions in the limited "H" being done. South Metropolitan was not active; but it was very firm, and went a point higher. Commercials were quiet and unchanged. The Suburbans and Provincials were absolutely stagnant—no business, and no movement of any sort. The Continental Companies were not far removed from stagnation—a few dealings in Imperial Continental alone breaking the void, and quotations remained unvaried. Among the rest, Australian debentures advanced a point; but Orientals were fractionally lowered, through apprehension lest the plague should extend and arrest business as it did in Bombay, which is not probable. Business in the Water Companies was at a very low ebb; and quotations were almost entirely unchanged.

The daily operations were: On the opening day, Tuesday, business in Gas was very quiet indeed. Prices, however, gave evidence of a strong tendency, though quotations did not move. The general characteristics on Wednesday were the same; but quotations did move. Gaslight "A" improved 2; and Australian, 1. There was a little more activity on Thursday, with a still favourable tendency. Gaslight "A" had a further advance of 3. Business on Friday showed signs of quieting down again; but all prices remained good. South Metropolitan gained 1; but Orientals receded ¼. In Water, New River debenture fell 1. Saturday was quiet and steady; and quotations closed without further variation.

ELECTRIC LIGHTING MEMORANDA.

The Accounts of the Shoreditch Vestry Electricity Supply Department—A Criticism—The Working Results—The Subsidy out of the Rates.

THE accounts of the Electricity Supply Department of the Shoreditch Vestry for the first nine months' working, ending at the close of the municipal year, have been published and criticized in "Lightning." It is understood in electrical-municipal circles that the eyes of the world are upon Shoreditch, watching eagerly for the triumph of the experiment of combined electric lighting and "dust" destruction there being carried on. The note of triumph has already been sounded by the Chairman of the department—indeed, the works had only been open for a week or two when this perfervid gentleman began calling upon the universe to bear witness to the success of the undertaking; and after six months' working he wanted to reduce the charges for current in view of the tremendous profits that were coming in. The majority of the Vestry, however, prudently preferred to wait and see what the first year's accounts looked like before giving anything away. Now that the first statement of accounts has appeared, though the period covered is not a full year, they turn out according to the judgment of our electrical contemporary to be "so badly arranged as to render very obscure the actual results attained." This is very deplorable indeed. A critic in our contemporary avers that the usefulness of the first published Shoreditch accounts "as a financial record is rendered practically *nil* by the obsolete method of compilation adopted by the accountant." This being the case, we shall not take the trouble to examine the statement for ourselves, as in the instance of St. Pancras, because it is evident that accounts so prepared might be made to prove anything. The reputation of Vestry accountancy is not so spotless that it can afford to challenge admiration for candour and completeness irrespective of the mere form into which the figures are cast. The returns are correct, of course; but it does not necessarily follow that the full cost of any department of the local authority is made visible to the naked eye by the entries purporting to relate to its operations. It is complained that the Shoreditch accounts are not presented in the form prescribed by the Board of Trade for

statutory electricity supply undertakings; and some people are certain to be uncharitable enough to entertain the suspicion that there must be some reason for this unconformity.

It is to be understood that the complaint refers only to the form of the accounts, which are thus blamed for obscuring the "excellent results" of the operations of the electricity works. It is too soon to talk of the results in this laudatory strain. For the nine months there was a total revenue of £6140 upon a capital outlay of £87,802; and the "total costs" only amounted to £2243, or 36 per cent. of the revenue, which is an indication that the undertaking had not settled down upon its bearings. The gross profit shown amounts to £3897, out of which, after paying interest and the sinking fund instalment, there remains an apparent surplus of £974. This is evidently the figure that is intended to stick in the public memory. It is characterized as "a cheerful realization of the expectations of the Committee." It is also advanced as "a helpful argument for those enlightened members of the Hackney Vestry who are striving for the establishment of a similar undertaking for their parish; and it very successfully dispels the absurd statements of their opponents that Vestry electricity works for Hackney will mean an increase of the rates of a shilling in the pound." Meanwhile, it may be mentioned that the Shoreditch Vestry paid £2283 for nine months' electricity for public lighting, which is something towards a subsidy. The ardent advocates of the municipalization of electricity supply never acknowledge the existence of this element in their way of working out the problem of making the business pay. Wherever a Local Authority—be it Corporation, District Council, or Vestry—undertakes electric lighting, the application of the system to all the public buildings and the most convenient streets is the first thing to be provided for. A company cannot reckon upon any such nucleus for a lamp connection. It may be said, of course, that in charging themselves an average price of 2·69d. per unit for the electricity supplied to the public lamps, the Shoreditch Vestry are doing very fairly by the ratepayers. But seeing that an arc lamp takes half a unit per hour, this means a charge of (say) 1·35d. per hour for every such lamp, or for 4000 hours' lighting an annual bill for electricity alone of £22 10s.—not an unprofitable bit of business. The truth of the matter is that every project of municipal electricity supply requires to be considered strictly upon its merits. The Shoreditch experiment may or may not turn out a success, according to the standard applied to it, and the point of view from which it is criticized. But neither the standard nor the point of view of Shoreditch need necessarily exist for the next parish, nor for any other local government district in the kingdom. That is the principle for which we are satisfied to go on contending in this column. There is no saving grace in the blessed word "municipalization" to convert a poor district for electric lighting into a paying one. The character of the district, in the commercial sense, is everything; the other considerations of electricity supply—system of distribution, dust destroying combination, company administration, or public control—are but incidentals. Why else should the stock of one electricity supply company stand at a premium that gas proprietors might envy, while that of another is unquoted?

WALMISLEY ON FOUNDATIONS.

At a recent meeting of the Architectural Association, a paper was read by Mr. A. T. Walmisley on "Foundations as Applied to London Buildings and Riverside Foundations," the text of which, with the illustrations, will be found in the "Builder" for the 28th ult. Those of our readers who are interested in the subject of foundations—and what engineer is not?—should possess themselves of a copy of the paper, for it is a most valuable contribution to the literature of this important subject. Mr. Walmisley's reputation as a careful, well-instructed engineer and informing writer upon engineering topics will be enhanced by his thoughtful essay. The subject of foundations underlies, in every sense, all other considerations respecting building construction. As he was addressing a London assembly, and as there are more buildings in London than anywhere else, Mr. Walmisley very justifiably devoted the first part of his paper to a description of the kind of foundations which those who would build in London must provide. His method of stating the requirements of this class of work, however, is of universal validity, so that constructors in other localities may profit by what he has to say concerning the foundations of a London bank or monument.

As Mr. Walmisley shows, the first care of a wise builder will be to inform himself with regard to the natural geological features of the site he has to deal with. In the case of London, all the necessary information upon this head is to be found in a pamphlet written by Mr. Horace B. Woodward, F.R.S. The Museum of Practical Geology in Jermyn Street, also, is an invaluable source whence the most complete information of the same kind is to be obtained for all parts of the kingdom. The builder, however, has to dispose of problems presented by the surface soil, with which geology has little or nothing to do. He has to reckon with "made ground," which in an old settlement may be of very considerable thickness. Moreover, the influence of artificial as well as natural drainage must be regarded. Hence, though the importance of trial boreholes for ascertaining the character of the subsoil of a building site cannot be overrated, it must be borne in mind that they cannot be depended upon to reveal the whole truth. "Thus, at the Admiralty extension new buildings forming Block 2, now in course of erection by Messrs. John Mowlem and Co., one of the boreholes upon the south-west side of the old buildings showed the clay to be about 29 ft. 6 in. below the surface of the ground, while actual excavation proved the dip of the clay to be such that in the execution of the new building it became necessary to underpin the north-west corner of the old building at the deepest part, 42 feet below the ground." This is the sort of "secret" that brings contractors into bankruptcy, when they have neglected to take the necessary precautions.

All over London, the general rule is to get down to the ballast or to the London clay; but Mr. Walmisley gives some instructive examples to show what the observance of this rule entails in practice. It so happens that a vein of running sand may be met with where the strong clay or gravel has been scored out by an old watercourse, In such a case (the Ediswan Electric Light Company's premises in Parliament Street) Messrs. Holloway Bros. met the difficulty by driving small piles, 7 or 8 feet long and 6 inches round, as close together as possible over the whole foundation, then sawing off the tops level, and forming a concrete raft 7 or 8 feet thick over the whole area. The City Hall, Belfast, stands on a piled foundation; the site being a deep stratum of yielding alluvial deposit. This is called, we believe, "slob" land. The Belfast practice in building on such land is to pile with larch, as long as it can be had, then to lay sleepers over the heads of the piles, and cover with a concrete table.

Concrete, of course, is the one modern contribution to the resources of the maker of foundations. It requires to be used with judgment. Mr. Walmisley says that concrete footings provide a distribution of weight over the whole area when a sufficiency is used. Concrete is also quite as good as brickwork or masonry to bring the work up to the surface under ordinary circumstances. But in the case of piers subject to vibration, brickwork is decidedly preferable. Brickwork piers, moreover, may be of smaller dimensions than concrete piers. An advantageous use of concrete in foundations where there is a good bearing underneath much bad soil, is to carry down piers to the sound bottom, and connect them at the top by a continuous slab of concrete over the intervening bad ground left in. It is an additional safeguard if steel beams are built into this concrete lintel. Some heavy buildings at Stratford, Lea Bridge, and Bermondsey are supported in this way.

As to the strength of concrete, as used in foundations, Mr. Walmisley adopts the proportion of seven of the agglomerate to one of portland cement. This he declares will safely bear a load of 5 tons per square foot, which is as much as ordinary brickwork ought to carry on the footing. Mr. Walmisley pronounces in favour of portland cement as the binding material for concrete for foundation work; but he records that the concrete foundations of the Royal Courts of Justice are made with selenitic lime, and that blue lias lime concrete was used by Mr. Basil Slade for the foundations of the new Institution of Mechanical Engineers, at Storey's Gate, Westminster. It is a very general practice in London to cover the whole site of a building with a slab of concrete, sometimes 8 feet thick, forming one block with the concrete piers or thicker blocks under the main walls. Sometimes the concrete slab contains a gridiron of steel to prevent cracking. Foundations that rest upon the firm ground of clay or gravel which is to bear ultimately the superincumbent mass, belong to a distinct order of such works. Where it is not intended to so base the weight of the building, but to carry it on a float of concrete, with or without piling, resting upon ground recognized as compressible, the foundation belongs to a different category. By the latter, sound buildings are carried upon sites that do not possess the quality of solidity essential to the former order of foundations. A large area of Eastern and South-Eastern London is characterized by a subsoil of peat, peaty clay, and wet sand of considerable depth. Mr. Walmisley cites the example of a building at Canning Town, known as Mansfield House, where a concrete raft 3 feet thick, in which were embedded rolled steel joists 8 inches by 3½ inches, was laid upon the surface of the ground. At the back of the house, the top of the concrete was 18 inches above the natural level of the ground. As the building went up, the raft sank nearly uniformly, but only by a few inches. If Mr. Walmisley had inquired of Mr. Livesey concerning the foundation of the retort-houses at the East Greenwich Gas-Works, he might have added another interesting example to his collection of modern instances of this principle of construction.

One of the most important, as well as the most ticklish, of all kinds of foundation work is underpinning, In all its developments, this is almost a modern art. It springs from the necessity, now of common occurrence, for building a new structure adjacent or near to an existing one, but with foundations carried to a lower depth. What this means is disclosed by Mr. Walmisley in respect of "the execution of a contract for demolishing an old building in Maiden Lane, Strand, and building a new one, three storeys below ground and ten (subsequently reduced to seven) above, where the site adjoined a court 3 feet wide, upon the opposite side of which was a four-storey warehouse." The

author lays down the general rule that in a job of this description the work should be set out so as to be executed in sections of about 5 feet to 10 feet in length—one length being completed before the next is begun; so that there may always be one or more undisturbed pieces between the section in progress and the previously finished section. He then discusses the incidental processes of needling and shoring.

A heavy job of underpinning described by Mr. Walmisley was the preservation from destruction by settlement of the Great Yarmouth Town Hall, in regard to which several leading engineers were consulted. Ultimately the work was effectually done by a method of screw piling, with cross girders, as advised by Mr. F. E. Duckham. A tremendous business, well treated by Mr. Walmisley, was the slipping of the London clay at the Denmark Hill Station of the South London Railway, where the line passes through a deep cutting. Two years were occupied in curing this trouble; and 10,000 cubic yards of concrete were buried, in the shape of a retaining wall and counterforts, before the earth movement was arrested. This was a particularly costly lesson on the old text of the unreliability of undrained clay.

The chief merit of Mr. Walmisley's paper, as might be inferred from the preceding cursory observations, consists in the number and precision of his cited examples. He does not stop to generalize, but is mostly content to let the record speak for itself. If a fault must be noted, it consists in the lack of systematic arrangement of the matter, which, it must be confessed, is thrown together in a decidedly "higgledy-piggledy" manner. There is in the paper pretty nearly everything that a student of engineering construction wants to know about foundation work; but it has to be hunted up and sorted out. As the legendary Scotchman remarked of sheep's head, there is a deal of "fine confused feeding" in this memoir. Its very irregularity imparts to it an air of life and correspondence with the facts that a quite formal composition is apt to lack. Not the least of the author's merits is his chronological range. He tells how the foundations of the old London Bridge were laid; and he also describes the Greathead system of tunnelling, and the method devised by M. Dulac for consolidating the subsoil of part of the site of the French Exhibition of 1900. By the way, did not somebody once propose to strengthen a weak subsoil by the expedient of piercing it with small boreholes, and afterwards pumping cement grout through them? Mr. Walmisley does not mention this, and we do not know if it was ever tried on a practical scale. We mention it chiefly because re-perusal of the paper tends to confirm the impression first created by it—that the story of modern improvement in the laying of foundations for buildings and engineering structures is compressible into the single word "concrete." Beyond this, there is nothing which a mason of the Middle Ages would have to learn from a present-day contractor, if he were to return to earth for the purpose of carrying on his old business. The modern contractor does not always get down to the bed-rock for his work, nor devise a reliable floating substitute; but neither did the old masons, if one may speak from the example of Peterborough. Bad work, unhappily, is of no single era; and a study of Mr. Walmisley's examples conveys the impression that, on the whole, modern engineers know how to found their structures so that they have as great expectation of enduring as the Pyramids themselves, and are infinitely more useful during their lifetime.

THE VALUATION OF FUELS.*

THE valuation of fuels by strictly scientific methods is now generally accepted by technical men as an indispensable adjunct to practical trials. Without means of determining the amount of heat which the combustion of a certain quantity of fuel will liberate, it would be impossible to estimate the efficiency of boilers, stoves, gas-engines, &c., or to make useful comparisons of the value of different fuels. But if the amount of heat which is liberated on the combustion of a given quantity of a fuel is known, we are in a position to judge the extent to which any heating appliance utilizes the heating value of the fuel. Hence we are able with certainty to detect and to reject inefficient apparatus, which, without such means of detection, might be allowed to waste the resources of the fuel for many years. The energy stored up in the fuel may have been used with little loss to effect mechanical work the results of which may remain as a permanent memorial of the utilization of the fuel; and in such a case, the fuel will have been well spent, and the apparatus used for its consumption highly efficient. On the other hand, the energy of the fuel may have been almost wholly frittered away in low-grade heat, with which no useful purpose can be achieved. In this instance, the resources of the fuel will have been misspent, and the apparatus in which it was consumed very inefficient. The energy of the fuel, when once dissipated in this manner, cannot be recovered; and to all intents and purposes such wasteful consumption of fuel is an irreparable injury inflicted on the world at large. A soil may be exhausted by the repeated growth upon it of certain crops; but rest, or the application of manures, will restore its virtues. The exhaustion of a coal-mine or of an oil-well is, however, a very different matter. We possess no means of restoration. The coal or oil once consumed is gone for ever; but if it has been judiciously spent, something of permanent utility will remain in order to compensate the community for its loss. Waste of fuel, however, provides no similar compensation; and the loss cannot be retrieved. Therefore it becomes a paramount duty of everyone to check waste of fuel, wherever it occurs. Nothing has conduced to the prevention of this waste more than the scientific study of the true heating value of fuels. It has led to their proper appreciation, and brought home to us a sense of the folly, injury, and sinfulness of their wasteful consumption.

Scientific study of the value of fuel is impossible without means of determining the maximum amount of heat which is afforded by the combustion of the fuel. This determination is made directly by means of the calorimeter, or indirectly by analysis of the fuel and reference to the results of earlier determinations with the calorimeter. The valuation of fuels rests, either directly or indirectly, solely on determinations made with this instrument; and hence the description of the various forms of calorimeter, and the methods of using them, must occupy a prominent position in any practical text-book on fuel.

Mr. Herman Poole, in the work of 248 pages now before us, devotes 62 pages to this portion of his subject; and it is only by dint of careful compression that he treats it adequately. His descriptions of the different calorimeters are concise; and his directions for their use are brief, but sufficiently lucid. The Junkers calorimeter for estimating the calorific power of gaseous fuels is familiar to many of our readers;* but we believe it has not met in England with the recognition it deserves. Mr. Poole confirms this impression; for he speaks of the instrument as having been used for some time in Germany and in the United States only. In this country, gas companies are harassed by stringent regulations concerning the photogenic value of the gas they supply, though the determinations of this value are insusceptible of being made with a high degree of accuracy. The calorific power—which has become, since the general use of gas engines, stoves, and incandescent burners, equally important to the consumer—is, however, quite disregarded, though the determination can be made with great accuracy with comparatively simple and inexpensive apparatus. The disproportionate attention which is paid to testings of illuminating power, probably accounts for the neglect of Junkers' calorimeter and of gas calorimetry in this country. With the rapidly increasing use of the gas-engine, the gas-fire, and the incandescent system of gas-lighting, the present anomalous and irksome methods of regulating the quality of gas supplies cannot long continue to prevail.

Mr. Poole's book deals with all classes of fuels; but coal naturally receives the larger share of attention. Of liquid fuels, petroleum, shale oils, and vegetable and animal oils are considered; and the results of a number of tests are given. We observe, with surprise, that there is no allusion to the value of tar or of the dead tar oils as fuel, though it is well known that they are extensively used for firing furnaces. Even if they are generally utilized in other directions in the United States, we should have expected to find records of their calorific value in the extensive series of tables of the heats of combustion of fuels, which occupy many pages of Mr. Poole's work. To bring the matter nearer home to the author, we would ask if he has not known instances of the use of the tar from carburetted water-gas plant as fuel. Even if he could furnish no data concerning the value of this tar, or of coal tar or tar oils, as fuel, he should not have completely ignored them in an otherwise comprehensive treatise on fuels. This is the only omission of much importance we have noticed in the book. The tables already mentioned are a most valuable collection of the results of nearly all reliable calorific tests of which particulars have been published. The names of the observers are given wherever known; but it would have facilitated the procuring of supplementary information concerning any tests, had the references to the original records been added. We think the portions of the tables which refer to British coals and gas might easily have been made more extensive.

The work gives the report presented in December, 1897, of the Committee on Boiler Tests of the American Society of Mchanical Engineers. This report contains a number of excellent "Rules for Conducting Boiler-Trials," which may be read with advantage even by experienced men. We notice that the determination of the moisture in coal is said to be made *accurately* by drying a weighed sample of the coal in a roughly-crushed state for one hour, in an air or sand bath, at 240° to 280° Fahr., and then weighing; and repeating the heating and weighing until a minimum weight has been found. We were under the impression that this method of determining moisture in coal had been thoroughly discredited for accurate researches; but it is possible that the objections raised to it by English chemists do not apply when the coal under test is different in character from most English coals.

We think there is scope for Mr. Poole's text-book on the calorific power of fuels, as existing works do not appear to cover precisely the same ground. It seems to be a very careful compilation; and we have not detected errors of any moment in the immense amount of numerical data which it contains. A

* "The Calorific Power of Fuels. Founded on Scheurer-Kestner's 'Pouvoir Calorifique des Combustibles.'" By Herman Poole, F.C.S. New York: John Wiley and Sons. London: Chapman and Hall, Limited; 1898.

* See "JOURNAL," Vol. LXV., pp. 644, 1374.

minor point is that the style and language of the text are a great improvement on those of contributions from Mr. Poole's pen which we have read in some of our American contemporaries. We are disposed to distrust the teachings of the scientist whose diction is loose, and are glad to see that the work before us is free from gross literary faults. The hyphen is, however, put to a variety of uses which may easily lead to misconception on the part of some readers. Scheurer-Kestner we have heard of; but we did not know that Dr. Hempel generally passed as Walther-Hempel, and Dr. Bueb, of Dessau, is scarcely recognizable as Bueb-Dessau. Probably German usages of the hyphen have confused Mr. Poole in two of these cases.

PERSONAL.

Sir ARTHUR FORWOOD was last Wednesday re-elected an Alderman of the Liverpool City Council. The circumstances under which he resigned have already been noticed.

The shareholders of the Staffordshire Potteries Water Company have decided to grant their late Secretary, Mr. J. B. PIERCY, a pension of £250 per annum. Mr. Piercy was in the service of the Company 32 years, and retired owing to ill-health.

On Friday, the 27th ult., the officers and foremen on the staff of the Rochdale Road Gas-Works, Manchester, met in the Committee Room at the works to present Mr. J. D. ASHWORTH, the Chief Draughtsman and Engineer's Assistant, with a handsome marble timepiece, on the occasion of his relinquishing his present post for that of Assistant-Engineer at the Portsmouth Gas-Works, to which he has been recently appointed. The presentation was made by Mr. G. E. Stevenson, the Chief Engineer, who on behalf of those assembled expressed the esteem and regard which the staff felt towards Mr. Ashworth, who has been thirteen years in the service of the Corporation, and in recent years has been responsible for the preparation of the drawings for all the important extensions and improvements which have been carried out under Mr. Stevenson at the different works of the Corporation.

OBITUARY.

The death is announced of Mr. J. BARKELEY SMITH, for some years a member of the Liverpool Corporation, and Chairman of the Health Committee. He was connected with various public companies, among others with the Liverpool United Gas Company, of which he was Vice-Chairman.

The death is announced, in his 78th year, of Mr. D. M'CALLUM, of Omagh. Deceased had been Manager of the Omagh Gas-Works for a great number of years, and was the senior member of the North of Ireland Association. It will probably be remembered that the meeting of the Association last year was held at Omagh, in order that the members might testify their regard for their colleague; and notwithstanding Mr. M'Callum's advanced age, his works were found to be well up to date.

By the recent death of the Deputy-Governor of the Isle of Wight (Mr. A. HARBOTTLE ESTCOURT, J.P.), the Newport Gas Company have lost their Chairman and one of their earliest Directors. Six years ago, deceased lost a nephew, Mr. Arthur Sotheron-Estcourt, LL.B.; and he never recovered from the shock. The name borne by this gentleman is associated with Metropolitan gas legislation; the Chairman of one of the Committees of the House of Commons who inquired into gas affairs between 1858 and 1860 being Mr. Sutton Sotheron-Estcourt.

We regret to record the death, on the 28th ult., after six months' illness, of Mr. JOHN GRAHAM, the Manager of the gas and water works of the Birstal Urban District Council. Prior to taking this position, which he had held for sixteen years, he was for nearly a similar period Manager of the Stockton and Middlesbrough Water-Works, under the late Mr. Thomas Hawksley. In his early days he was connected with the gas-works at Elland and Darlington. Deceased was for several years a member of The Gas Institute and the Manchester District Institution; and at the funeral last Tuesday Messrs. R. Porter and G., H., and J. Niven, members of the latter organization, were present. Deceased was 64 years old. He leaves a widow, two daughters, and a son—Mr. Arthur Graham, the Manager of the Mansfield Corporation Gas and Water Works.

The death of Mr. ALEXANDER J. DOVE, which took place at his residence, Highfields, East Grinstead, last Wednesday, in his 85th year, removes another of the few remaining representatives of the official side of the gas industry in the Metropolis in the pre-amalgamation days. Mr. Dove's life was practically passed with the London Gas Company. He had been for a long time in their service when, in 1869, an accident deprived them of their Secretary, Mr. J. R. Hinde, who had held the position for thirty years; and Mr. Dove was appointed as his successor. Just at that time their Engineer (Mr. Watson) died; and Mr. Robert Morton left the Phœnix Company to take up his duties. Mr. Dove retained the Secretaryship till the amalgamation of the Company with The Gaslight and Coke Company in 1883. His connection with the gas industry, however, was not severed. He was a Director of the Ottoman Gas Company, and on the death, in 1894, of the Chairman, Mr. Edward Horner, Mr. Dove succeeded him. This position, as well as his directorship, he was compelled to relinquish a few months ago, on account of ill-health; and his successor (Mr. J. Le Geyt Daniell) testified, at the meeting of the Company last March, the great regret of his colleagues in accepting his resignation.

On Sunday, the 29th ult., a long life devoted to scientific, political, and administrative work was brought to a close by the death of Lord PLAYFAIR. Born at Meerut on May 21, 1819, he had just completed his 79th year. In early life he showed a predilection for chemistry; and as a young man he studied this science under Graham at University College. He subsequently went to Giessen to work with Liebig, some of whose books he translated into English. In 1843, he was appointed Professor of Chemistry at the Royal Institution, Manchester; and three years later he became Chemist to the Museum of Practical Geology. He was a Special Commissioner of the Great Exhibition of 1851, his services in connection with which were rewarded by a Companionship of the Bath and an appointment in the household of the Prince Consort. In 1856, he became Professor of Chemistry in the University of Edinburgh, and held the position till 1869. He was Chairman of the Finance Committee of the English Commission of the French Exhibition of 1878, and President of the Civil Service Commission in 1874; and for many years there was scarcely an official inquiry in which he did not take part. He entered Parliament in 1868, was Postmaster-General in 1873, and Chairman of Ways and Means in 1880. This office he resigned in 1883; and on his retirement was made a K.C.B. In 1885, he was Vice-President of the Council. He was created a peer in 1892; but his elevation did not interfere with his activity upon Commissions. He was a member of many learned societies at home and abroad, and was Senior Past-President and last surviving founder of the Chemical Society, as well as a Past-President of the British Association. His business capacity also found considerable scope in the commercial world. The funeral took place on Saturday last, at St. Andrews.

The funeral of Mr. ROBERT WALLIS, J.P., the Chairman of the South Shields Gas Company, whose death was announced in the "JOURNAL" last week, took place on the 1st inst, at Bywell St. Peters, in the presence of a large number of relatives and friends of the deceased. The Company were represented by the Vice-Chairman (Dr. J. F. Armstrong, J.P.); Alderman W. R. Smith, J.P., and Colonel W. J. Dawson, J.P., Directors; the Engineer (Mr. W. J. Warner); the Secretary (Mr. J. H. Penney); the Auditor (Mr. H. Chapman); the Solicitor (Mr. J. H. Moore, J.P.); Messrs. J. A. Purvis and J. G. Pilmour, officials from the Secretary's office; and Messrs. J. R. Lackland, Bamford Williamson, and E. F. Williamson, shareholders. The Ex-Mayor (Alderman J. Bowman, J.P.) was also present. The funeral service was conducted by the Rev. Dr. Stenhouse, assisted by the Rev. Anthony Johnson and the Rev. Canon Dwarris. The coffin was of polished oak with brass mounts, and bore the following inscription: "Robert Wallis, born 27th October, 1810. Died 26th May, 1898." Reference was made last week to Mr. Wallis's long connection with the South Shields Gas Company. He presided over no less than twenty-two half-yearly and forty annual meetings, besides special assemblies—in fact, he was very rarely absent from any business meeting. He was a pillar of strength to the Company, especially at critical periods when courage and nerve were needed, as he was ever prompt to decide in emergencies. He was very broad in his views, and invariably took a firm stand when the Company's interests were assailed. As an instance of this, it may be mentioned that in 1879, when the Company went to Parliament for further powers, they were strongly opposed by the South Shields and Jarrow Corporations, who invited the Directors to go to the South Shields Town Hall and discuss the various matters of difference with the united Town Councils. The event is memorable for the able defence of the Company's policy by the Chairman, resulting in an amicable arrangement. These were the occasions when Mr. Wallis's tact and ability as a Chairman shone out. He was ever loyal and courageous in the cause of the Company; and it may truly be said that he did yeoman service in its behalf. A testimonial was presented to Mr. Wallis by the proprietors some time ago; and the public paid him a similar compliment when he gave up his medical practice thirty-eight years since. At the meeting of the South Shields Town Council last week, the Mayor (Alderman Imrie) referred to the loss sustained by the town by the death of Mr. Wallis, and moved a resolution recording the Council's sense of deceased's worth, and expressing their sympathy with his family in their bereavement. This was at once agreed to.

We regret to record the death of Sir ROBERT RAWLINSON, K.C.B., which occurred last Tuesday afternoon, at his residence in South Kensington, in his 89th year. He was born in Bristol, on Feb. 28, 1810; his father being a mason and builder carrying on business at Chorley. He began life as a working stonemason. One of his first engagements was with Jesse Hartley, the famous engineer of the Liverpool Docks, whose office he entered at the age of 21 as a measurer of masonry. In 1836, he was in the service of Robert Stephenson, acting as Assistant Resident Engineer on a section of the London and North-Western Railway at Blisworth, where the construction of the line gave so much trouble to all concerned. In 1840, he returned to Liverpool as Assistant-Surveyor to the Corporation. On the passing of the

Public Health Act of 1848, which may be regarded as in large measure the outcome of Mr. Edwin Chadwick's inquiries into the sanitary condition of the labouring population of this country, he was one of the first Inspectors appointed. Early in 1855, he was one of the Sanitary Commission sent out to the Crimea to examine into the causes of, and find remedies for, the unhealthy state of camp and hospital. The result of their visit was a remarkable fall in the death-rate. In 1863, he was associated with Mr. Farnell in carrying out a Government scheme of public improvements for a number of towns in Lancashire, with a view to giving employment to the large numbers of operatives who had been deprived of their means of livelihood by the American War. In this way a sum of about £1,850,000 was spent; and Mr. Rawlinson was made a C.B. in recognition of his services. On the constitution of the Local Government Board, he became Chief Engineering Inspector; and in 1888, upon retiring from the post, which he had held for sixteen years, he was promoted to be K.C.B., having already been knighted in 1883. In addition to his official duties, he was Chairman of the Royal Commission on the Pollution of Rivers in 1866, and also served on the Commission which inquired into the sanitary condition of Dublin in 1879. He became an Associate Member of the Institution of Civil Engineers in 1848, and was President in 1894. He was a recognized authority on drainage and water supply. As far back as 1846, he proposed to supply Manchester and Liverpool with water brought by an aqueduct from Lake Bala; but the project was rejected on the ground of expense. He did not support the present scheme of the London County Council for bringing water to the Metropolis from Wales. Sir Robert was an honorary member of the Society of Engineers, in the proceedings of which he took considerable interest; manifesting this by giving an annual premium for one of the papers presented. Last year it was awarded, appropriately enough, to Mr. R. E. Middleton, one of the Joint Engineers of the Staines Reservoirs Scheme, for his paper on "The Pollution of Water, and its Correction."

The Pintsch System of Gas Lighting.—At present the Pintsch system of gas lighting is in use on 85,600 cars and locomotives in the world. In but few of the countries where this method of lighting has been adopted has it been used on locomotives; and Germany is the only country that has so applied it to any considerable extent—there being at the end of last year 2955 locomotives in that country lighted by the system. Brazil comes next, with but 31 such installations. Germany is the only country where the number rose from the end of 1896 to the end of 1897; the increase in this case being 166. Last year there were 6089 coaches equipped. In 1883 there were but 11,422 installations on cars and locomotives. In five years the number had increased to 26,100, and in ten years to 54,175.

"Field's Analysis" for 1897.—Mr. J. W. Field, the Secretary and General Manager of The Gaslight and Coke Company, has issued, in the usual form, his analysis of the accounts of the principal gas undertakings in England, Scotland, and Ireland for the past year. The difficulty of presenting trustworthy figures in regard to some of the averages "per ton," owing to the extension of the manufacture of carburetted water gas for other than enrichment purposes, has led Mr. Field to decide on limiting his comparisons, in future, to the figures of the cost of gas per 1000 cubic feet sold, except in those cases where the actual quantity of coal carbonized has a direct relation to the figures to be compared—as, for instance, the quantity of coke made, or the value of the residuals produced, per ton of coal.

Metropolitan Water Supply Commission.—The twenty-fourth sitting of the Commission (being the first after the Whitsuntide vacation) was held yesterday at the Guildhall, Westminster—Viscount Llandaff presiding. Sir Alexander Binnie, the Chief Engineer to the London County Council, who was under examination when the Commission rose for the holidays, was recalled and further questioned by the Chairman with reference to the method by which he proposed to partition the works of the various Water Companies in Essex, Hertfordshire, and Kent. With regard to Kent, the arrangement would resolve itself practically into this—that the new body, whatever it was, which would be constituted to purchase the Companies' undertakings, would obtain in bulk from Kent the quantity of water at present supplied from this source to London.

Proposed Organization of Capitalists and Free Labourers.—In his capacity as Chairman of the Council of the Free Labour Association, the Earl of Wemyss has issued a memorandum addressed to all employers and employers' associations, in which he points out that Trade Union leaders are endeavouring to bring about a great federation of Trade Unions, with the view of getting rid of capitalists and of all employers other than the Government for the time being in power, and of nationalizing capital. The dangers that thus threaten employers, capitalists, free labourers, and the national well-being can, it is believed, only be successfully combated by forming a great defensive organization of capitalists and free labourers such as the Association is striving, outside of party politics, to bring about. He asks for the support of all who love liberty, alike of employers and employed, and hate tyranny, individual or collective; and he concludes by saying that the Association must in no way be considered hostile to Trade Unions as such, but only to the tyrannical exercise of their power.

COMMUNICATED ARTICLE.

THE THREE-LIFT GASHOLDER AT SUTTON.

WITH REMARKS ON CONSTRUCTION.

By F. S. Cripps, Assoc.M.Inst.C.E.

II.—*Guide-Framing* (*continued*).

The general principles observed in designing the guide-framing, may be summed up as follows.

(1) *To do away with unnecessary weight*, without reducing the strength and stiffness of the structure. This is achieved by consistency in design—that is, by making all parts equal to the work required of them. The old engineering proverb about the strength of a chain being only that of its weakest link, is too often disregarded. Gasholders are frequently to be met with having one part or detail of the guide-framing several times stronger than necessary, while other parts may be the very opposite—that is, there is no consistency or uniformity about the strength and suitability of the various links which go to make up the whole chain in the design. One gasholder may be double the weight of another, and yet only half its strength, owing to the improper disposition of the material.

(2) *To economize work*—that is, to reduce the cost of manufacture and erection to a minimum. This is effected by the above-mentioned lightness and stiffness and *simplicity* of construction, in having few parts to handle, and repetition rather than variety of parts, sections, lengths, &c. This will be more apparent after a consideration of the various details hereafter described.

(3) *To avoid water traps*, loose work, and other encouragements to rust and decay. This can only be done by carefully exposing every part to the paint brush—that is, there must be no recesses or cracks which the brush will not easily enter and well paint. Liners must be fixed in all positions where narrow spaces are unavoidable. The pitch of the riveting must be such as will admit of the rivets drawing the parts tightly together, without gaping open between the rivets.

(4) *To have a good appearance.* This object is best attained by avoiding all (so called) ornament, such as rosettes, whether on the lattices to girders or standards; fancy rings and devices at the intersection of diagonal ties; and finials or crowns on the standards. All these things are out of place, and are totally useless. The lattice form of construction gives perhaps the best appearance. It looks light and rigid, owing to the standards being deeper than they would be with solid-plate webs. Every member or limb of the structure should show forth its object and suitability to attain that object, and nothing more; then, from an engineering point of view, it cannot fail to be of pleasing proportions and appearance.

Standards. In designing the standard, it is necessary to provide against (*a*) bending backwards or forwards, (*b*) bending sideways, and (*c*) twisting. This means that the standard must be (*a*) sufficiently deep from back to front, (*b*) it must be sufficiently broad to give side stiffness, and (*c*) the front and back flanges must be connected by horizontal stiffeners, and well bracketed to the girders.

Section of Standard. In the present instance, the type of standards adopted may be described as I shape in section, approximating to T shape—the table of the tee (or front member) being narrower than is usually the case in the ordinary T section. This type of standard was adopted after due consideration of all other kinds (see Note A).

Front and Back Flanges. The section of the Sutton gasholder standard is shown on Drawing No. 3. The front flange consists of a plate (15 inches wide) stiffened on the edges with light angle irons. The channel-iron guide backs hard against this plate, which with the tee iron behind, completes the section of the front flange. The same rivets take the channel guide, the table plate and the tee iron, thus making a very simple and solid job. The back flange is formed of tee iron having a 12-inch plate riveted to the table to give the required sectional area and lateral stiffness. It is a common practice to use two angle irons instead of a tee iron, for the flanges in standards of this class, which not only means double the number of bars to punch and handle, but it is impossible to paint between the angles, the space being only sufficient, as a rule, to take the flat iron bracing. The tee iron, however (as shown on Drawing No. 3), does away with all these disadvantages.*

Riveting. The rivets are ¾-inch diameter throughout, and the pitch is not greater than necessary to secure the requisite strength and tight work, and to avoid trapping water in cracks, &c., by parts springing open between the rivets.

Top and Bottom. At the top, the back flange of the standard is curved over to meet the front one; and at the foot, the front and back plates are slightly increased in width. The expense of this shaping at the top and bottom is but trifling, and is fully justified by the improved appearance and rigidity.

Bracing. The front and back flanges of the standards are united by simple cross-bracing of light channel irons, which act

* It is very desirable that the channel-iron guide should back hard against the standard, and form a part of the front flange, as in this case. It not only stiffens the standard, but reduces the twisting or side strains. It also does away with all special brackets or chairs, and makes a solid and unyielding path for the rollers to work against.

either as struts or ties, as occasion requires. By this means the redundant *horizontal* bars, often found in standard bracing, are avoided. Flat iron is unsuitable for struts of this length; whereas channel iron, besides making excellent struts, adds lateral stiffness to the standard.

Junctions, &c. Each standard is in three lengths, the junctions occurring on the centre line of the girders. All the irons (except the channel guide) are joined at one level and do *not* "break joint." This is a radical departure from the accepted theory, that all irons should break joint with one another. But there are good reasons for making this change. In the first place, the weakest part of the standard is not opposite the girders, but midway between two tiers of girders, and if it failed, that is where it would yield, not at either of the junctions. The strongest place is opposite the girders (in spite of the joints), as at this level it is well gusseted and strutted against buckling. By grouping all the joints at one level, both the construction and the erection are greatly facilitated. One can ensure all the irons absolutely butting; the sections being cut off flush in one plane. If they "break joint" they seldom butt properly, and many more rivets must be left out for putting in on the job during the erection, besides requiring more rivets and cover plates than would otherwise be the case. There is also considerable variation in the lengths of the different bars when they "break-joint;" the projecting ends being very frail for transit. Altogether, as the standard is not weakened by the departure, it will be seen that there is considerable advantage in not blindly following a rule, just because it happens to be a rule. Generally speaking, all irons are united with simple flat-iron cover plates, instead of the usual round-backed angle-irons.

Stiffeners. The structure is stiffened very much by the gusset angles (or diagonal stiffeners), extending from the front and back flanges of the standard to points some distance along the girders, as shown on Drawing No. 3. The standards are also further stiffened at intermediate points, by horizontal stiffeners lightly braced together.

Attachment at Base. The front plate, channel-iron guide, and side angle irons of the front member, are all carried down and bolted to the *front* of the cast-iron base; the angle irons and channel iron guide being carried still further down, and attached to the base-stones in the tank wall, as shown on Drawing No. 5. By this means a good grip is obtained for the standard in the front. The foot of the standard is bolted down to the cast-iron base through the strong angle irons shown on Drawing No. 5, and which angles connect to the web plates, as well as to the front and back flanges of the standard. The cast-iron bases are planed on the top surface, and are each held down by the four holding-down bolts already described. Handholes are provided in the top of the bases, to admit of putting in the bolts for attaching the standards. [In passing, it may be mentioned that very frequently such provision is forgotten, thereby increasing the trouble of erection, as the bases then have to be fixed to the standards before the latter can be erected. The bases should always be set out in the exact positions and centres, and fixed perfectly level on the tank piers, before erecting the standards.]

The bases and holding-down bolts are afterwards grouted up flush with cement, through these handholes, thus making everything solid.

It will be observed that the diagonal tie is taken right into the base; the eye being held fast by the pin passing through the jaw cast in the interior of the base. This makes a neat finish, and brings the pull directly under the centre of the standard, and is very simple and strong. [Frequently great wrought-iron wing plates are attached to the web plates, involving much greater expense, making a very springy job, and unsightly to look at. Strong plates lapping behind the back flange of the standards are also objectionable.]

Girders. The girders in each bay are fixed in a plane which passes through the *neutral axis* of the standard. The diagonal ties are likewise in the same plane; neither the girders nor ties being attached to the back or front flange alone, as is so commonly done.

The girders are formed of broad tee irons (no table plates), with light flat-iron bracing (single triangulation), a single ¾-inch rivet taking the two bars at each junction. The girders are joined (through the standard) by continuous web plates, as shown on Drawing No. 3, and united to the standard by stiff channel irons, to which they are attached at the top and bottom flanges, and also by the diagonal stiffeners already described.

Diagonal Ties. The diagonal ties are connected to the standards and girders, at each end, by strong channel-iron brackets or loops, which serve the all-round purpose of taking the ties, uniting the girders, and stiffening the frame-work. The ties (with the exception of those which enter the base) have no eyes or jaws. The adjustment is made by tightening the nuts on the screwed ends, where they pass through the channel bracket above referred to. The ties are continuous, and are destitute of ornamental rings, plates, &c.

Wind Ties. Wind ties (or Paddon's ties) connect the tops of the alternate standards. They are formed of round iron rods, screwed at each end, and passing through cast-iron bevelled washer plates. They are supported by brackets from the intermediate standards in the usual way.

Exact Dimensions. It may be mentioned, that not only the guide-framing, but the entire gasholder, has been made to the exact calculated dimensions; nothing being left to be measured up during erection before the work could be finished, as used to be the case in olden days. If a gasholder is accurately made, and set out properly during erection, there is no need for closing dimensions, &c., but everything will come together easily and true, as it has done in this case.

Standards to be Plumb. It is a great mistake to incline the tops of the standards inwards—they should be perfectly plumb. The idea that the inclination of the standard would provide against the contraction of the diameter, as each lift cups with the next, needs but a moment's reflection to expose its absurdity. It is only the top curb which contracts in diameter, drawing off the *top* rollers (due to the pull of the top sheets inwards, as explained in "Guide Framing of Gasholders," p. 53). It does not affect the *grip* rollers on the other lifts. This contraction of the top curb does not occur *gradually*, but happens, as it were, *suddenly*, as each lift cups. Hence the guides would require to be stepped forward to meet such a case; but neither this nor the inclined standard would do, as the grip rollers do not require any such provision to be made. The grips do not draw off the rollers from the guides as the hanging weight increases, but, if anything, the reverse. But for this suggestion having been recommended in two text-books already, it would not be considered worthy of notice. It cannot, however, be too strongly condemned.

Note A.

The ordinary I-*shaped plate girder* standard is simple, easy to construct, easy to paint, and can be made free from rust traps. All the sectional area is available to resist the dead-weight. It, however, lacks side stiffness, unless the intermediate framing (girders and diagonal bracing) is very close together, so as to support it at several points in the height. It looks flimsy and ugly. It cannot be climbed like a lattice standard (a disadvantage when erecting it, if at no other time). There is also more punching and riveting required for web plates, than for lattices. The best examples of this style of standard are to be seen in connection with Mr. Livesey's holders, at the Old Kent Road and East Greenwich works.

The *four-post standard* (or square type), consisting of four angle irons (one at each corner), possesses great stiffness in any direction. But it is somewhat complicated to construct, and wastes a lot of material in lattices and web plates—all four planes or sides requiring bracing, instead of only one. The front guide-rail requires special support, as it cannot back solidly against the standard flanges, but comes between them. It is awkward to attach girders and diagonal ties, and requires cross stiffening to prevent twisting. It is also difficult to avoid water traps and to paint. The best examples are those of Mr. Trewby's, to be seen at Beckton, Kensal Green, and other works.

Double Channel Section—This is a cheap, simple, and stiff form of construction, and can be made free from rust traps. The greatest objections to it, are, that it requires two planes of lattice bars one on each side, and that these lattices must be attached outside the flange to avoid water traps. The outside lattices do not improve the appearance. Mr. Corbet Woodall has designed gasholders of this type of construction. One may be seen at Guildford.

Tee Section—The front member being of broad lattice construction, so as to give great side stiffness, thereby avoiding the necessity of many tiers of girders. These standards have a nice appearance, and when properly bracketed between front and back flanges, are very stiff and secure against twisting. The girders can be attached to the front member, reducing their length somewhat. It is, however, an expensive construction, possessing many parts. It is complicated where the lattices cross in the front member behind the guide. The junctions are also difficult to arrange, and great care has to be taken to avoid water lodgments and rust. This is a very favourite type of gasholder, and reference may be made to the holders designed by Mr. Charles Gandon, at the Crystal Palace Gas-Works.

Other Sections—There are many other kinds; notably Mr. Hunt's standards, with round flanges—that is, the front and back members each constructed of a wrought-iron column united by cast-iron struts and wrought-iron bracing. These are very fine examples of large holders; but scarcely a suitable type for small ones. Mr. H. E. Jones's tripod or double standards may also be mentioned.

Lord Rayleigh on Heat-Engines.—At the Royal Institution recently, Lord Rayleigh brought to a close a course of lectures he has been delivering on the subject of "Heat." On a previous occasion, he dealt with Carnot's theories respecting the efficiency of reversible heat-engines; and he now further discussed the subject—pointing out that it carried with it a definition of absolute temperature independent of any particular kind of matter. The conditions of obtaining this theoretical efficiency were next considered; and it was stated that the highest efficiency yet known in practice is about 0·2, or, in other words, that only one-fifth of the heat taken from the boiler is converted into work. This very moderate efficiency might, the lecturer said, be increased by the use of increased working temperatures; but it was difficult to do this with water or with other liquids having higher boiling-points. The difficulty was evaded in another form of heat-engine—the gas-engine, where the heat is developed in the cylinder itself. Good gas-engines gave an efficiency of 0·25; and it might be expected that this would in time be raised.

THREE LIFT GASHOLDER — SUTTON GAS-WORKS — No 3.

DETAILS OF STANDARDS, GIRDERS, DIAGONAL TIES, WIND TIES &c.

SCALE OF FEET

14 STANDARDS.

LENGTH OF GIRDERS ON CENTRE LINE

TOP TIER	=	28-0 EXACTLY
MIDDLE —"—	=	28-1⅛ —"—
BOTTOM —"—	=	28-2⅜ —"—

DIAGONAL TIES

TOP TIER	38-5⅛ LONG OVER ALL SCREWED WELL DOWN
MIDDLE	38-5⅛ " " " "
BOTTOM	39-10 FROM CENTRE OF EYE IN BASE TO END OF SCREW

SECTION AT E.F.

SECTION AT C-D.

FRONT ELEVATION OF TOP

SECTION AT A-B.

SECTION AT G-H.

COVER PLATE TO BACK FLANGE

FRONT ELEVATION

SIDE ELEVATION OPPOSITE 1ST TIER OF GIRDERS (FROM GROUND)

ENLARGED DETAIL OF TIE JUNCTION.

SECTION AT I-J

SECTION SHOWING STIFFENERS.

FLANGES OF ALL C.I. LATTICE BARS TO BE SAWN OFF ON THE BEVIL AS SHEWN IN PLAN

NOTES !

¾ RIVETS TO BE USED THROUGHOUT THE GUIDE FRAMING UNLESS OTHERWISE FIGURED ON THE DRAWINGS

BOLTS MAY NOT BE SUBSTITUTED FOR RIVETS. NO LODGEMENTS OR RECESSES FOR WATER TO BE FORMED

THE PITCH OF LATTICES IN WEB OF STANDARD = 4'-4¾ THROUGHOUT. TAPER OF STANDARD 9/64 IN 1-0

ALL PARTS TO BE TIGHTLY RIVETTED TOGETHER AND ALL EXPOSED SURFACES TO BE EASILY ACCESSIBLE FOR PAINTING. THE EDGES OF FRONT FLANGE PLATE TO BE PERFECTLY FLUSH WITH THE FRONT ANGLE IRON & CAULKED WATERTIGHT. ALL DIAGONAL TIE RODS TO HAVE 3" DRAW & DEEP NUTS.

FOR DETAILS OF BOTTOM OF STANDARD AND BASE. SEE DRAWING No 5.

F.S. CRIPPS. A.M.I.C.E. ENGINEER

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TECHNICAL RECORD.

THE INSTITUTION OF GAS ENGINEERS AND THE TEMPERATURE OF GAS MEASUREMENT.

The Committee's Final Report.

At the Annual Meeting of the Institution of Gas Engineers two years ago, a Committee, consisting of Messrs. A. Colson, C. C. Carpenter, C. Hunt, F. Livesey, J. Methven, R. O. Paterson, G. C. Trewby, and L. T. Wright, was appointed to consider the questions of the proposed standard of light and the temperature of gas measurement. It will be remembered that the first report of the Committee, of which Mr. Hunt is the Acting Chairman, dealing with the subject of the standard of light, was issued early in the present year, and was published in the "JOURNAL" for Jan. 18 (p. 124). It was signed by all the members except Mr. L. T. Wright, who, having left the Institution, relinquished his place upon the Committee; and since then another member —Mr. John Methven—has been removed by death. Their colleagues have now issued their final report, dealing with the second subject referred to them—viz., the temperature of gas measurement; and it will come up for consideration at the approaching annual meeting. The Committee state that at their first meeting on June 11, 1896, the matter was entrusted to a Sub-Committee, composed of Messrs. Colson, Hunt, Livesey, and Paterson, whose report is given below. It embodies the results of observations conducted by each of the members separately; and the Committee express their agreement with the conclusions to be drawn from them. They record their deep regret at the loss of Mr. Methven, whose assistance in the first part of the investigations proved, from his special and intimate knowledge of photometry, of the highest possible value.

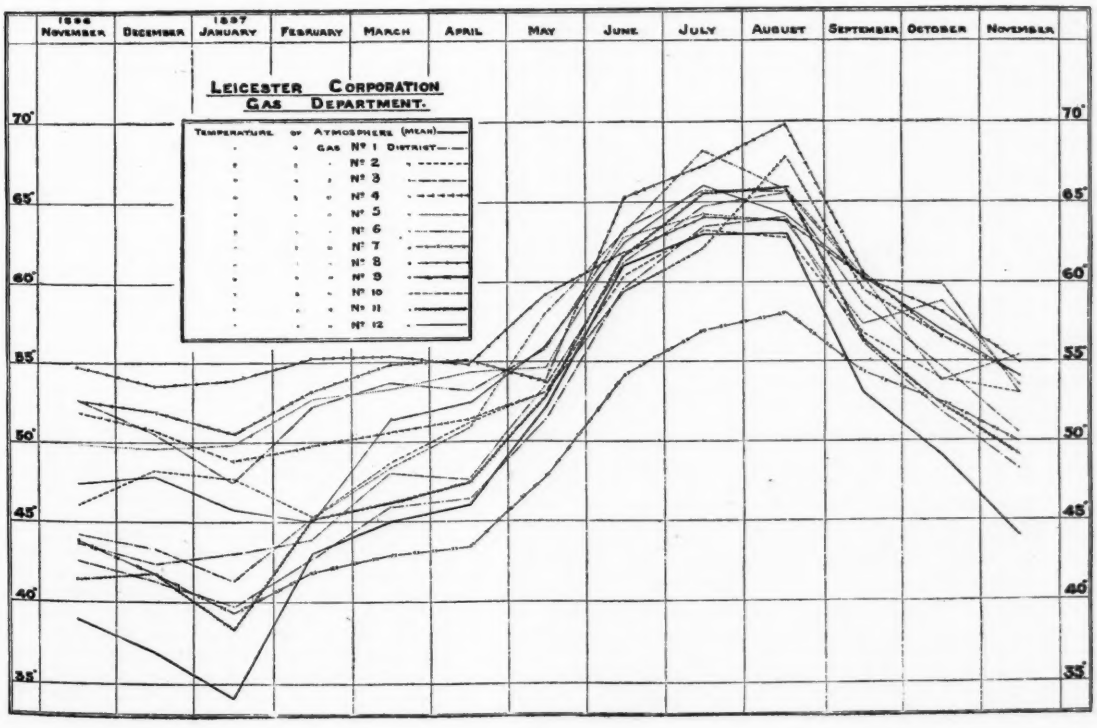
REPORT OF THE SUB-COMMITTEE.

The Sub-Committee submit particulars of observations of temperature made in their respective districts, and extending over a considerable period of time. These have been plotted out in diagrammatic form, so as to bring more clearly to view the point of the investigations. They prove that the temperature of the gas at the consumers' meters follows that of the air; although it is not always subject to the same variations as the latter, owing probably to the more or less sheltered positions of the meters. Thus, while extreme variations of 27° and 29° Fahr. occur in the air temperature, those of the gas temperature, during the same period, ranged from 28° down to about 11° Fahr.

It will be seen from the observations that the gas temperature only approximates to 60° during the four or five summer months. Throughout the remainder of the year, and especially during the period of heaviest consumption, it falls considerably below 60°; the lowest monthly average recorded being 35°, which is a

Leicester Corporation (Aylestone Road Works).

Distance from Works and Number	At Works. 1		1¼ Mile. 2		¾ Mile. 3		¾ Mile. 4		½ Mile. 5		3¾ Miles. 6		1¾ Mile. 7		1¼ Mile. 8		1¾ Mile. 9		2¾ Miles. 10		1 Mile. 11		¼ Mile. 12	
Description of Meter	400-Light Wet.		300 Light Wet.		150-Light Wet.		150-Light Wet.		500-Light Wet.		50-Light Wet.		150-Light Wet.		150-Light Wet.		5-Light Wet.		3-Light Wet.		3-Light Wet.		3-Light Wet.	
Date.	Average Atmospheric Temperature at Works.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.
1896.																								
Nov.	39	56	42·57	42	46·00	42	43·66	42	51·80	42	49·97	42	52·61	42	52·57	52	54·75	58	43·84	58	44·27	58	41·44	58	47·32
Dec.	37	56	41·26	36	48·13	36	42·44	38	50·73	38	49·57	33	50·66	37	51·89	62	53·50	62	41·72	62	43·29	62	41·74	60	47·61
1897.																								
Jan.	34	46	39·69	34	47·64	34	43·00	34	48·88	34	49·97	34	47·55	34	50·54	50	53·94	50	39·40	38	41·21	50	38·44	50	45·72
Feb.	43	56	42·71	38	45·31	38	43·97	36	49·77	36	52·66	38	52·13	36	53·08	56	55·25	56	41·96	56	45·32	56	45·17	56	45·00
March	45	62	45·87	50	48·64	50	48·02	48	50·56	48	53·25	50	53·62	50	54·96	62	55·46	62	42·87	62	48·43	62	46·06	62	51·48
April	46	60	46·21	44	51·15	44	47·52	37	51·37	37	54·35	34	53·14	34	55·02	60	54·83	60	43·46	60	50·90	60	47·46	60	52·36
May	52	52	51·46	40	53·07	32	53·40	33	53·06	32	54·57	34	55·85	33	48·69	52	59·34	54	47·72	54	58·12	54	52·72	54	55·92
June	61	54	59·59	32	60·46	29	61·17	16	59·50	16	62·75	25	63·44	26	65·23	53	61·86	60	54·06	58	63·29	60	61·56	52	62·46
July	63	52	63·44	39	63·38	37	64·86	31	62·16	27	64·36	28	65·71	26	67·30	52	64·11	30	57·00	56	68·19	56	65·57	56	66·00
Aug.	63	62	64·03	38	62·97	38	65·50	27	67·85	28	63·78	27	65·62	26	64·92	58	63·82	60	58·06	56	65·75	54	65·92	59	64·30
Sept.	53	60	56·26	44	56·86	41	58·72	39	59·53	39	57·46	43	60·04	43	60·55	56	60·32	60	54·30	32	60·37	40	56·40	45	60·37
Oct.	49	62	51·77	24	53·91	24	54·58	36	56·66	36	58·94	28	59·92	10	56·60	40	58·15	62	52·43	60	53·86	62	52·33	58	55·96
Nov.	44	6	48·16	4	53·00	4	50·50	4	54·00	4	53·50	4	53·00	no r	ecord	6	55·00	4	50·00	4	55·50	4	49·00	6	54·00



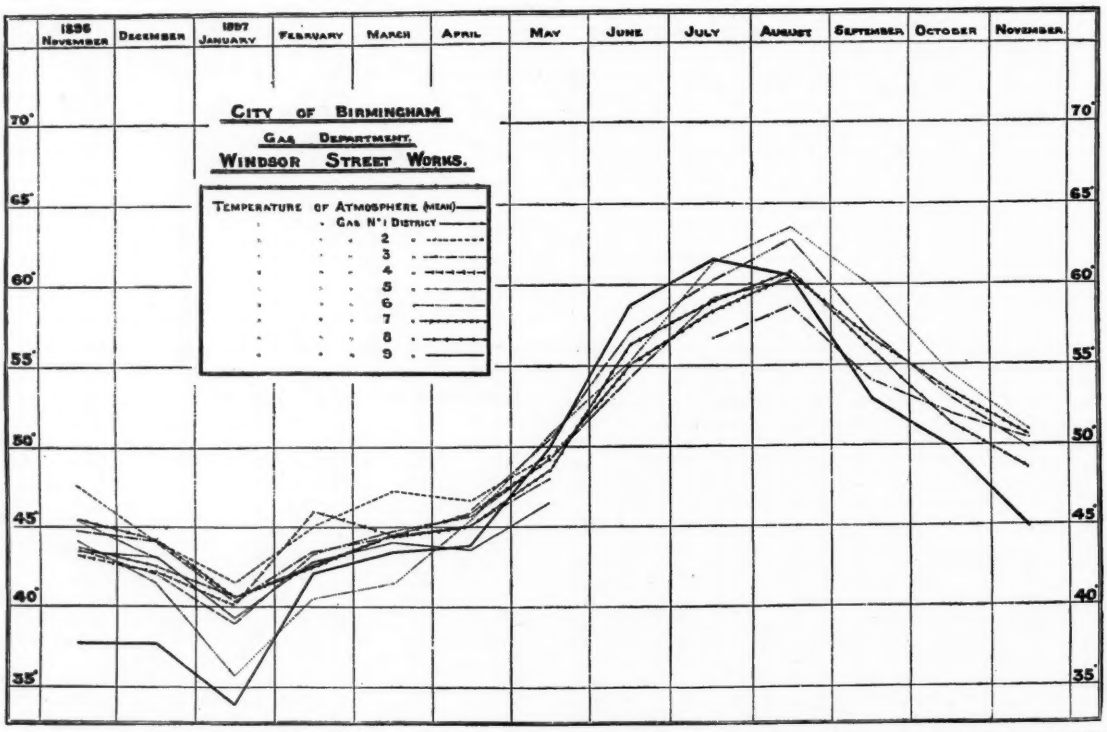
ifference of 25°, and would represent a contraction of volume of more than 5 per cent. The customary correction of the make to 60° Fahr. is therefore of little use for the purpose of comparing gas sold with gas made, and only tends to increase fictitiously the quantity of so-called leakage or unaccounted-for gas.

In order to determine with some degree of accuracy the actual loss due to leakage, imperfect registration at the consumers' meters, or other causes, this source of error requires to be eliminated. For this purpose, it seems to be necessary to vary the corrections (say) weekly, following the ascertained atmospheric temperature, but adding thereto or deducting therefrom a few degrees to compensate for any higher or lower observed average temperature at the consumers' meters. This compensation does not, however, seem to be invariably required, since the records show in two instances a close agreement between the temperatures of air and gas.

ALFRED COLSON. FRANK LIVESEY.
May 2, 1898. CHAS. HUNT. R. O. PATERSON.

City of Birmingham (Windsor Street Works).

Distance from works and number		About 2 Miles. 1		About 7 Miles. 2		About ¾ Mile. 3		About ½ Mile. 4		About 1½ Mile. 5		About 1½ Mile. 6		About ¾ Mile. 7		About 1½ Mile. 8		About 1½ Mi'e. 9	
Description of meter		20-Light Wet.		5-Light Dry.		5-Light Wet.		5-Light Wet.		5-Light Wet.		5-Light Wet.		3-Light Wet.		5-Light Wet.		3-Light Wet.	
Date.	Average Atmospheric Temperature in Birmingham	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.
1896.																			
Nov.	37·7	48	44·8	25	47·5	22	43·5	25	43·2	24	41·1	23	45·3	15	45·4	26	43·6	25	43·4
Dec.	37·7	59	44·0	29	44·0	30	42·0	31	42·1	26	41·4	22	43·0	9	44·2	30	42·4	31	43·0
1897.																			
Jan.	34·0	62	40·3	23	41·5	31	39·0	30	40·2	28	35·7	no	record	24	40·6	26	40·6	31	39·2
Feb.	42·0	56	43·4	26	45·0	27	43·3	28	46·0	22	40·5	,,	,,	28	42·5	28	42·4	28	42·7
March	43·4	57	44·4	31	47·2	30	44·7	12	44·5	24	41·4	,,	,,	31	44·5	31	44·5	31	44·0
April	43·7	49	45·1	30	46·6	30	45·6	no	record	29	45·4	28	46·0	27	45·8	27	45·0	30	43·5
May	49·9	38	47·9	12	49·3	27	49·2	,,	,,	26	50·7	31	50·5	31	49·2	31	48·4	31	46·4
June	58·7	no	record	no	record	29	54·3	,,	,,	24	55·2	30	57·1	30	55·0	24	56·2	no	record
July	61·5	35	56·7	,,	,,	31	59·2	,,	,,	24	61·3	30	60·2	30	58·3	28	59·0	,,	,,
Aug.	60·5	14	58·6	,,	,,	25	60·3	,,	,,	28	63·6	15	62·8	18	60·5	31	60·8	,,	,,
Sept.	52·9	28	54·1	,,	,,	no	record	,,	,,	24	60·0	30	57·0	30	56·6	30	55·9	,,	,,
Oct.	49·9	19	52·0	,,	,,	,,	,,	,,	,,	26	54·5	31	53·0	31	53·4	31	51·3	,,	,,
Nov. (to 15th)	44·8	11	50·4	,,	,,	,,	,,	,,	,,	13	50·9	11	49·8	11	50·6	11	48·5	,,	,,



GAS-WORKS MACHINERY.

By EDWARD A. HARMAN, of Huddersfield.

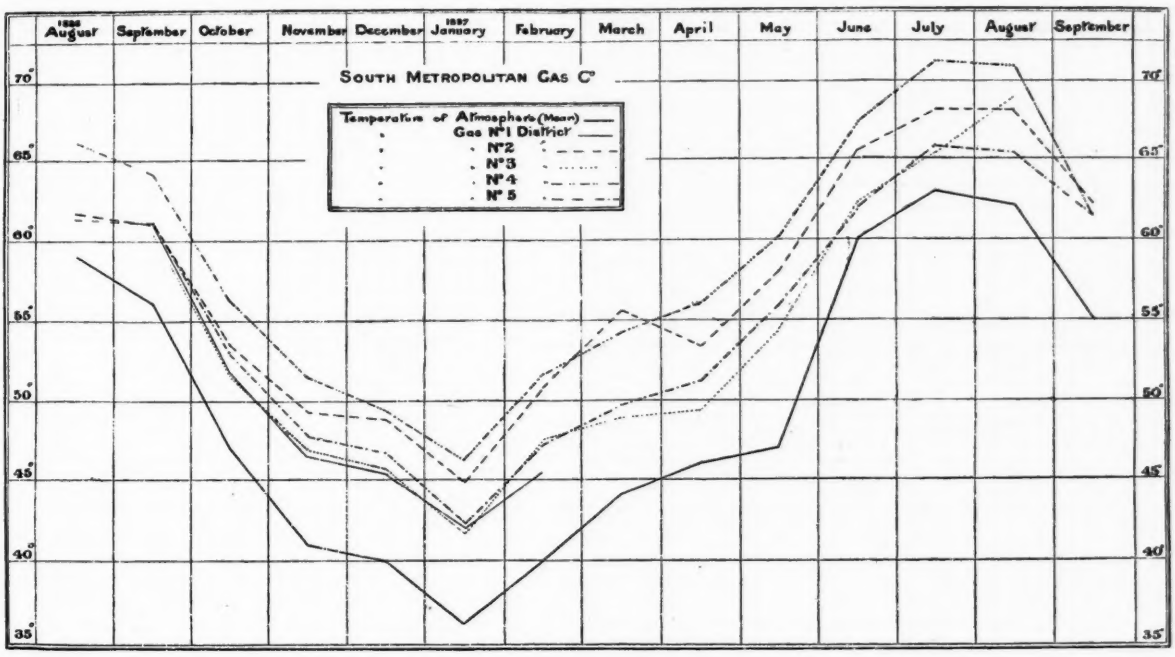
[A Paper read at the Society of Engineers last night.]

Gas-works machinery is in many respects so closely connected to several branches of engineering, as to make it somewhat difficult to distinguish it separately. The more prominent parts of the machinery have been made the subject of many valuable papers read before this Society. This alone renders the idea of producing anything new upon the subject almost beside the question. It is not only the latest idea which is worthy of consideration, but older and well-tested systems. By careful consideration of these, improvements are effected which add materially to their efficiency and life. It has often been realized that, by concentrated thought, designs which seemed incapable of improvement have yielded to the touch of ingenuity and adaptation. Under existing conditions of carbonizing coal, many escapes of gas—such as are involved with the lifting of the purifier covers, and from open catch purifiers in connection with sulphate and other plants—are entirely unpreventable; while the smoke and steam add to the deteriorating influences. There is also a quantity of purifying material about the works, a portion of which is exposed to the atmosphere for the purposes of revivification. In addition, there is a quantity of waste lime and other material frequently in course of removal. The unloading of coal, and the screening and loading of coke, also circulates a large quantity of dust and grit.

An eminent chemist, one day, in passing through a gas-works

South Metropolitan Gas Company (Old Kent Road Works).

Distance from Works and Number		About ¼ Mile. 1		About 1¼ Mile. 2		About ¾ Mile. 3		About 1¼ Mile. 4		About 3½ Miles. 5	
Description of Meter		5-Light Dry.		5-Light Wet.		5-Light Dry.		5-Light Dry.		10-Light Dry.	
Date.	Average Atmospheric Temperature at Works.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.
1896.											
Aug.	59	no record		20	62·2	no record		18	66·2	11	61·4
Sept.	56	42	60·9	58	61·0	57	60·3	60	64·2	60	61·1
Oct.	47	58	51·7	65	53·5	65	51·6	64	56·3	65	53·8
Nov.	41	70	46·3	90	49·3	90	47·0	90	51·5	80	47·8
Dec.	40	75	45·4	92	48·8	93	45·6	93	49·4	91	46·7
1897.											
Jan.	36	78	42·0	93	44·8	93	41·7	93	46·2	93	42·8
Feb.	40	74	45·6	78	50·8	84	47·5	84	51·6	84	47·3
March	44	no record		10	55·6	93	48·9	93	54·2	93	49·7
April	46	,,	,,	60	53·3	90	49·4	89	56·0	90	51·2
May	47	,,	,,	60	58·0	92	54·3	83	60·1	93	55·8
June	60	,,	,,	49	65·5	90	62·3	67	67·4	89	62·0
July	63	,,	,,	62	68·1	93	65·3	78	71·2	93	65·9
Aug.	62	,,	,,	62	68·1	24	68·9	79	70·9	82	65·3
Sept.	55	,,	,,	18	62·2	no record		38	62·2	28	61·5



with the author, commented upon the objectionable odour he detected, and said he did not mind an equationable one. It is the inequationable gases that have their influence upon the machinery, as well as the others. Lime purification, and especially where the sulphur compounds in the gas are closely dealt with, necessitates the unloading of many thousands of tons of quicklime in the works, the fine dust from which is freely distributed.

Gas-works machinery has to deal with numerous combinations of unpurified gases, acids, alkalies, gritty and impure water, oils, and spirits. Some of the machinery is required to draw out hot coke from benches of ovens at a distance of from 3 to 4 feet from them; while the machines are subjected to all the influences of heat from the furnaces and material they are employed upon. The machinery, therefore, is not working under the same conditions as at other engineering works, where most of the influences named are absent. To meet these special requirements, necessity and experience have designed a whole collection of machinery, which possesses distinct features of interest and importance.

The extension of gas-works machinery is not merely an effort to "save another man," or to reduce working expenses. Apart altogether from the delights and fascination of invention, there is, or should be, the additional object of alleviating the more arduous and irksome work of those engaged. The lot of gas workers has been greatly improved by the adoption of machinery. Machinery reduces the actual unskilled labour on the works; but the manufacture and maintenance of it considerably increases the demand for skilled labour, which in itself is a great counterbalancing consideration for the labour market. The very existence of gas-works depends on the advance and improvements made from time to time in the machinery and plant.

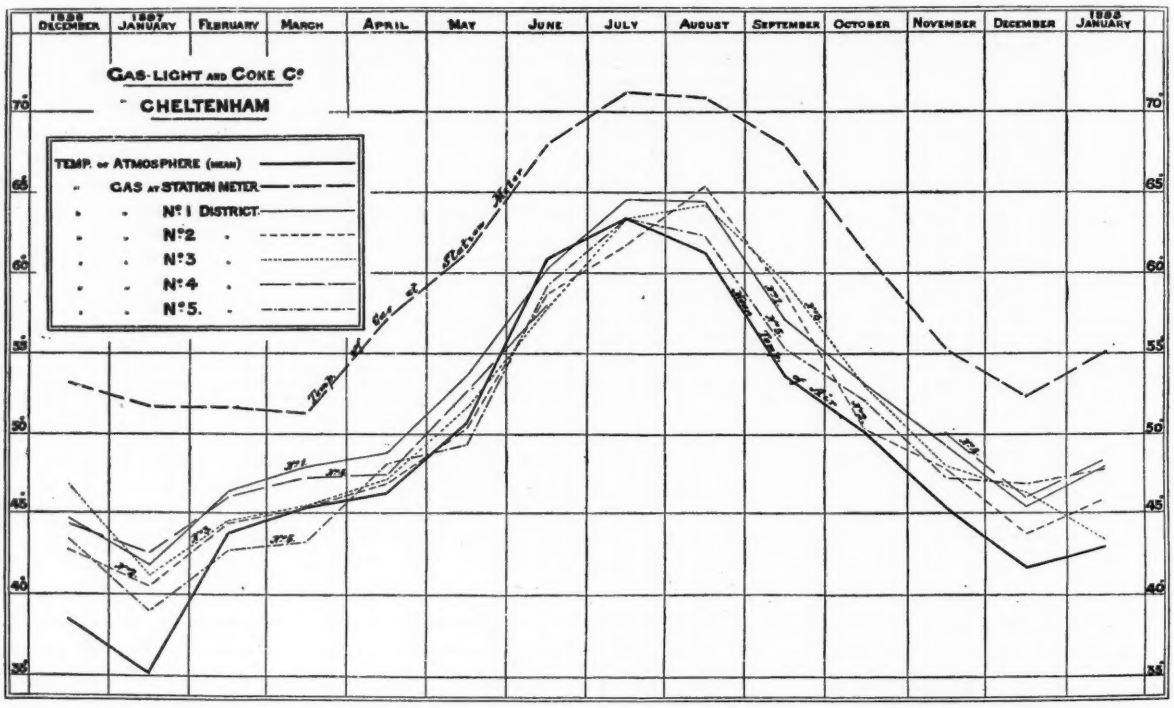
Mr. John Brunton, a predecessor of the author's at one of the Birmingham gas-works some sixty years since, experimented with an ingenious process, which he patented, for continuous carbonization. The bottom of the retort was placed at an incline, and was possibly the precursor of the subsequent inclined retort systems. The coal was propelled in from one end in small charges; the resultant coke dropping out into a water-trough at the other. This system has been tried since at various works, under different names, but has not been permanently successful. The most recent attempt at continuous carbonization is that known as the Yeadon revolving gas-retort.

Gas-works operations are frequently considered as the most exhaustive class of labour. Retort-house work is spoken of as though it were considerably harder in every particular than puddling furnaces. If a comparison could be drawn between the operations of match-making, phosphorus, chemical works, copper works, mill work, and gas-works operations, a different idea would at once prevail. Nearly every gas-works possesses novelties and ingenuities in machinery, which will well repay examination. In many cases, they consist principally of special adaptations to peculiar circumstances. At all events, one frequently learns from them what to avoid as well as what to adopt.

Gas manufacture is often considered as a purely chemical operation, which, although largely true, does not altogether exhaust the subject. To illustrate the magnitude of the machinery required, a few figures bearing upon the subject will suffice. According to the parliamentary returns of authorized gas undertakings in the United Kingdom, upwards of 12,250,000 tons of coal are carbonized annually. This produces 8,000,000 tons of coke, together with 2,000,000 tons of tar and ammoniacal liquor, and 130,000 tons of sulphate of ammonia; while for the quenching of the coke, 3,000,000 tons of water have to be obtained and distributed. It is not simply the carbonizing stages which have

Cheltenham Gaslight and Coke Company.

Distance from Works and Number		About ½ Mile. 1		About ½ Mile. 2		About 1½ Mile. 3		About 1½ Mile. 4		About 2 Miles. 5	
Description of Meter		80-Light Dry.		5-Light Dry.		5-Light Dry.		10-Light Dry.		10-Light Dry.	
Date.	Average Atmospheric Temperature in Cheltenham.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.	Number of Observations.	Average Temperature at Inlet.
1896.											
Dec.	38·5	61	44·7	41	42·7	110	46·8	58	44·4	44	43·4
1897.											
Jan.	35·0	46	41·8	29	40·5	101	41·1	53	42·5	57	39·0
Feb.	43·8	40	46·4	26	44·4	79	44·4	31	46·0	45	42·7
March	45·3	44	48·0	30	45·3	97	45·3	25	47·2	61	43·2
April	46·2	35	48·9	27	46·9	92	47·0	18	47·3	56	48·1
May	50·7	34	53·7	25	50·4	62	51·7	9	52·7	53	49·4
June	60·8	36	60·2	26	58·6	60	57·8	15	57·8	27	59·1
July	63·3	36	64·5	27	61·7	60	63·3	no record		31	63·2
Aug.	61·2	36	64·4	28	65·4	58	64·1	,,	,,	30	62·2
Sept.	53·7	34	57·1	22	58·8	58	59·5	,,	,,	60	55·3
Oct.	50·1	38	53·1	24	50·3	58	53·0	,,	,,	62	52·1
Nov.	45·3	42	49·3	28	47·9	61	48·0	25	50·0	43	47·2
Dec.	41·6	38	45·4	28	43·8	60	46·3	50	46·0	31	46·9
1898.											
Jan.	43·0	36	48·0	30	45·9	62	43·4	36	48·4	31	47·8



to be dealt with, but also the subsequent treatment of the various residuals and bye-products.

While large gas-works are frequently found to be well equipped with machinery, there are many medium-sized and small works existing in which much remains to be done. At a not very remote date, gas-works machinery was of the most meagre character. Thanks, however, to the enterprise and ingenuity of members of this and kindred engineering societies, such rapid improvements and developments have been effected, that many large gas-works have machinery of considerable magnitude and importance. It is to the further employment and adaptation of machinery for all available purposes that gas undertakings have to look in the future for the extension of their operations. It necessarily follows that, with such machinery in use, all kinds of lathes, shaping machines, and tools are required for their proper maintenance. Indeed, the author ventures to think that some of those engaged in what may be termed purely engineering works would be surprised to find the extent to which machinery is required and employed in gas-works. The rapid extension of carburetted water-gas plants (the gas from which can only be used sparingly), oil-gas plants, and the inclined-retort system necessarily minimizes the quantity of machinery required in gas-works; but whether these systems will continue to reduce the quantity remains to be seen, and can only be a matter of speculation.

The central and most important parts of gas-works machinery are the exhausters, although they act in the capacity of pressure-pumps as well. In the majority of works, the ascension-pipes leading from the retorts have arch-pipes at the top, which dip into a hydraulic main. In some few works, the dip-pipes have been abolished, and a dry main substituted. In connection with the subject of exhausters, it may be of passing interest to deal with a common fallacy respecting the function of this little understood portion of the machinery. It is not infrequently supposed that it is the duty of the exhausters to draw away gas from the retorts; whereas the object is purely to reduce the seal upon the dip-pipes themselves, and to draw away the gas from the hydraulic main alone, thus leaving room for the newly-evolved gas to take its place. As an example of this reduction of seal, suppose a hydraulic main to have a dip-pipe sealing to the extent of 3 inches. Upon the exhausters commencing duty with 2 inches vacuum, the liquor in the hydraulic main is at once raised; whereas that in the dip-pipe is depressed to but 1 inch seal, and through this seal the gas bubbles as it is made, practically forcing its passage. It is absolutely necessary that the dip-pipe should be always sealed, as if it becomes unsealed, the vacuum is at once put on the ascension-pipes; and supposing the retort-lid were open, this would admit of air being drawn up, composed by volume of 80 per cent. of a diluent gas, nitrogen. This would deteriorate the gas to an alarming extent, apart altogether from the danger of forming an explosive mixture. Not only so, but the unsealed pipe would prevent the other pipes in the retort-bench having their seal proportionately reduced; hence they would receive undue back pressure, and commence blowing at the joints of the retort-lids, &c.

Heavy back-pressure on the retort produces deposition of carbon on the sides of the retort. This is a heavy, hard, solid, stone-like substance, requiring to be either chipped off with strong bars or consumed away by leaving the lids open, or by any other specially provided means. The deposition of carbon

to the extent of 1 inch upon the interior of the retort would seriously affect the heats and the fuel account. In the early days of gas making, exhausters were not used—the gasholders having to be counterbalanced by heavy weights; but the carbon nuisance became so great as to ultimately lead to the adoption of exhausters. Another evil of heavy back-pressure is that the issuing gas, being unable to get away rapidly enough, is detained in the retort with the incandescent coke, and thereby becomes seriously decomposed. It is a common supposition that atmospheric air is deliberately drawn into the gas at the retorts through the exhausters. To assist purification at a later stage, it is sometimes found an advantage to admit a measured percentage of air, in order to utilize the 20 per cent. of oxygen (by volume) therein for assisting the revivification of the oxide of iron in the purifiers; but on account of the deleterious effect of the nitrogen, it has to be used with the greatest possible care. In my works at Huddersfield, in preference to this, an extensive oxygen-making plant is used, constructed under Brin's patents, and possessing many features of interest and importance. Supposing the dip-pipes became unsealed when the retort-lids were shut, the vacuum would then be upon the retorts direct; and as in the process of time these have cracks in them, the result of such vacuum would obviously be to draw the obnoxious furnace gases from the setting through the cracks, and hence into the gas-mains. The producer gas contains usually about 24 per cent. of carbon monoxide, and 8 per cent. of carbonic acid gas; while the spent gases, which would probably be those to be drawn in, consist almost wholly of carbonic acid and nitrogen. Apart from the non-luminosity of such gas, the purification required to eliminate it would be disastrous to working expenses. In gas-works where the hydraulic main has been superseded by a dry main, a slight back-pressure is also necessary on the retorts, or all the serious consequences mentioned would be liable to take place. Apart from these consequences, anything like putting a vacuum upon the ascension-pipes would have the inevitable result of drawing up small particles of coal dust and coke, and stopping them up with a hard tarry substance.

A further function of the exhauster is to force the gas which has been distilled in the retorts through the purifying and other apparatus of the works, and ultimately to raise the gasholders. Here, again, is a common fallacy—viz., that it is the lightness of the gas which raises the gasholders, after the manner of a balloon. Holders constructed of huge framework! In a gasholder of 200 feet diameter, having 8 inches water-pressure, the weight of iron represented equals nearly 600 tons. It is necessary that the capacity of the hydraulic main should be of sufficient size to allow all the pipes therein to remain sealed, in the event of the exhauster from any accidental cause ceasing work. In such a case the whole of the gasholder pressure would be at once thrown on to the hydraulic main, forcing the liquor contained therein up the dip-pipes to the maximum amount of the resulting pressure. It is this maximum pressure that has to be provided for. A few years since, exhausters were commonly driven by pulleys and leather belts; but now in many works they are driven direct from an engine fixed on the same bedplate. Of course the best form of exhauster is that which runs as evenly as possible, and gives the steadiest gauge. It is apparent that any unsteadiness of the engine might produce any or all of the undesirable possibilities to be avoided.

In designing the size of the exhausters, it is not sufficient to take the daily maximum make of gas, and divide it by twenty-four hours, and so obtain the hourly make. When the retorts are first charged, the quantity of gas travelling forward is more than at any later portion of the process of carbonization. The rapidity of the rate at which retorts are charged both by machinery and with the inclined system, produces a sudden rush of gas, which is very heavy, and has accordingly to be provided for. The high temperature of the gas as it issues from the retorts, has also to be kept under notice, on account of its larger volume at the higher temperature. Excessive speeds for the exhauster should not be adopted, as by so doing the already high temperature of the gas is increased. It seems to the author that circumferential velocity is the correct method for calculating the size of an exhauster; and a good average rate is about 800 feet a minute at the tip of the so-called exhauster blades.

Generally speaking, exhausters should not be constructed to pass more than between 200,000 and 300,000 cubic feet per hour. It is desirable, above that quantity, to put in another exhauster. The gas to be exhausted is unpurified, as the exhausters are generally placed at the outlet of the condensers. There is a large amount of tar, ammonia, and, indeed, all the other impurities, which have to be extracted in the further processes. The tar will, generally speaking, lubricate the exhausters sufficiently; but at times it is found desirable to add thick creosote oil, or a little thin tar, for additional lubrication. Under any circumstances, it is undesirable to use cheap machine oil for this purpose. When the exhausters are used simply for the purpose of delivering pure gas at a considerable distance away from the works, which is exceptional, any good machine oil may be used; although even then it is an open question whether creosote oil is not the most advantageous for the purpose. The engines for driving the exhausters are of simple construction, but necessarily require to be of a strong character, as their duty is severe. Regarding the horse power required for driving exhausting machinery, this varies according to the pressure and circumstances; and it is, indeed, very difficult to fix any approximate rule for the calculation. For many years makers of exhausters have been reproducing, with few important alterations, the familiar form of machine—namely, that of the rotary type, consisting of an eccentric barrel with a double slide. This is being very gradually improved upon. As regards the speed of exhausters, the general idea seems to be that, unless they rotate with great rapidity, very perceptible oscillations are experienced in the vacuum.

In connection with gas-works machinery, a larger use ought to be made of gas-engines. It is somewhat of an anomaly to be generating steam, necessitating powerful boilers, when there is such an ample supply of gas power always available.

Pumps are required on gas-works for numerous kinds of liquids of varying specific gravities, from light volatile spirits to almost solid matter, in the form of tar and pitch, the viscosity of which is very often fatal to the working of ordinary pumps. Pumps frequently have also to deal with cotton waste, small pieces of coke, and finely-divided matter, which have got into the liquid in some mysterious manner. There are also great variations in temperature to be taken into account. Sometimes the liquids are below freezing-point, and at others at a high temperature. Pumps in many places have to deal with canal water, containing every possible variety of suspended matter. In calculating the requisite pumps, the specific gravity of thick tar, pitch, &c., must be carefully allowed for, and not merely the 33 feet maximum for ordinary water-pumps considered.

Perhaps as important a question as any in connection with gas-works machinery is that of the most desirable lubricants. In many places machines are subjected to considerable heat, the effect of which, upon oils and lubricants generally, varies. It is not simply a question of volatilization or viscosity; but the question of the different residuals left from the oil has also to be considered. Much of the difficulty experienced with machinery has been due to insufficient lubrication and improper lubricants. In gas-works, the coal and coke dust have to be considered, and the sulphurous and other gases attacking every portion of metal for which they have any affinity. It is absolutely necessary that every part of the machinery not at work should be tallowed and greased, to preserve it ready for future service. It is a common error in many works to consider the machines only want overhauling and attention immediately preparatory to re-starting.

Stacking coal by machinery has not yet been largely adopted in the United Kingdom. The unloading of boats by means of grabs, &c., has certainly made a distinct advance. Upon some of the London works, there are magnificent installations of work of this character. In May last, at the Institution of Gas Engineers, Mr. Marshall, the Engineer of the Danish Gas Company, described the new coaling apparatus he had erected at the Fredericksberg Gas-Works.* The machinery consists of six cranes, with steel lifting-grabs, each weighing 3 tons; the total dead weight with the load of coal being 5 tons. There are also automatic cars constructed to carry 2 tons, discharging the coal into bins. These six cranes easily hoist 600 tons per hour, or 100 tons per crane per hour. Assuming the cranes work a minimum quantity of 480 tons per hour, this would equal, for a working day of nine hours, a discharge of 4320 tons. Assuming the cranes to be at work for six months in the year, or (say) 180 days, the total quantity of coal unloaded would be 777,600 tons. Mr. Marshall, however, does not anticipate, during the first few years at all events, that the annual quantity discharged will amount to more than 500,000 tons.

The Temperley transporter is admirably adapted for use under certain conditions, where a system of overhead transportation is required. It was introduced some five years ago, when the portable beam-type of transporter was tried with such marked success by the Admiralty for coaling men-of-war during the Naval Manœuvres of 1893. Since that time, however, the Temperley transporters have not only been generally adopted for this purpose by the British and other Governments, but they have been applied in a variety of new forms for many uses on shore; and they are especially found to offer distinct advantages over other appliances for special purposes. This is the case when a long outreach is necessary, and goods are required to be conveyed to a considerable distance from the lifting-point. A special feature of the Temperley transporter is a carriage (or traveller) of simple but ingenious design, working on an elevated truck, and provided with an automatic device by which the traveller is arrested and held stationary while the load is being lifted or lowered, and which also sustains the load while the traveller is moving. The operations of lifting, transporting, and lowering the load are effected by the simple action of hauling in and letting out a single rope. Any ordinary form of winch may be employed for working the transporter. The travellers are made of numerous sizes and patterns, suitable to the work required of them. At the Midland Coal Company's wharf at Woolwich, this transporter is used for discharging the coal from steam-colliers on to a coal-stack, and into waggons. The plant consists of a hollow steel boom, 83 feet long, suspended from a carriage which is traversed along the flanges of an overhead steel girder of 40 feet span, by means of an endless chain laid to a hand-crab. After being held in any desired position, the boom is made fast by guide-ropes, and remains stationary while the work proceeds. The automatic traveller used runs on a swinging track suspended from the

* See "JOURNAL," Vol. LXIX., p. 1120.

boom. It is operated, as before indicated, by a single rope attached to an ordinary steam-winch placed in an adjacent building. The track is fitted throughout its length with steps 5 feet apart, at any of which the traveller can be arrested, and the load lowered and deposited without breakage; the entire operation being under the control of the man stationed at the winch. The transporter is capable of making 60 lifts per hour, and the bulk of coal usually lifted in each scoop is 13 or 14 cwt., representing a duty of about 40 tons per hour. This type of transporter, which is largely used for stacking coal, &c., is made in sizes up to 100 feet in length, and to lift up to 14 cwt.

Coke conveying and screening by machinery are attended by many difficulties; the sharp, gritty nature of the material grinding the apparatus used. One of the best forms of coke conveyors in England which the author has yet seen, is that designed by Mr. Henry Hack, M.Inst.C.E., of Birmingham. It is in use at the City Gas-Works, Swan Village, near Birmingham, and consists of a continuous bucket-chain (Hack and Piggott's patent). The coke is conveyed from the cellars of the retort-house to the outside of the house, where it drops on to a conveyor placed at right angles, and is quenched. It is then carried up an inclined conveyor leading into a circular rotary drum placed at a suitable angle, composed of perforated plates having different sized meshes. Underneath this screen are placed two railway waggons, into one of which the dust falls, and into the other breeze, while at the lower end is placed a third waggon, which receives the coke that has traversed the entire length of the screen, not having sifted through the meshes referred to. It will be seen that hand labour is not employed upon the coal from the time it leaves the pit till it leaves the gas-works as coke.

On the Continent, one of the best designs the author has seen for coke quenching and conveying machinery, is that by M. De Brouwer, of Bruges.* It consists of a chain conveyor placed below the bottom row of retorts, the return chain of which is placed overhead in front of the ascension-pipes, and supported by brackets projecting from the buckstaves. The conveyor consists of a water-trough composed of plates and angle-irons, in which runs a skeleton conveyor, consisting simply of two flat-link chains, one on each side of the trough, having round bars fixed between them, at a distance of about 2 feet centres. Light tramways with endless rope systems are also successfully employed for conveying coke.

For many purposes coke is required of a small size, and breakers are now extensively used. Formerly the breaking was done by smashing the coke up with a block, or even with the back of a shovel. The smashing of coke in this way involved a serious loss of material. A good form of coke-breaker consists of a series of steel circular toothed discs for cutting the coke. The screening is now accomplished by machinery, and where power is not employed, there is generally a rotary hand-screen used, which answers the same purpose on a smaller scale. By this means hand-sieving and riddling are being superseded. The author witnessed a few years since, this hand-riddling being undertaken by a number of women. Thanks to the progress of civilization, that is altogether a matter of history. The dusty employment of hand-riddling is most objectionable to plant on the works; so that any apparatus to do this class of work mechanically is a distinct gain.

Gas-engines and tramcar motors may be perhaps regarded as being outside the range of gas-works machinery, inasmuch as, generally speaking, they are not used in the course of gas manufacture, although there are works where some of them are. It is, however, a distinct branch of gas engineering; and the use of gas for propelling tramcars has received a great impetus by the success of the Blackpool, Lytham, and St. Anne's tramway of about eight miles. Gas-engines are now made as large as 200 or 300 horse power, though the smaller sizes are mostly used.

Great advances have been made in the economizing of fuel for retort-furnaces by the use of regenerative settings, and by the employment of hot coke in lieu of cold coke or coal. In some works also, tar and oil are being used for fuel purposes; but they are obviously unsuitable in towns where stringent smoke restrictions are in force. In all large works, the retorts are heated by a system of regenerative furnaces, so that there is little difficulty in obtaining suitable heats for properly carbonizing the coal. At a gas-works visited by the author a few years since, he was informed that all the coke made was required for heating the furnaces, and, in addition, a small quantity of coal. It is now customary to reckon from 12 to 15 per cent. of the coal carbonized only as being required for fuel, or (say) 23 per cent. of the coke made; the balance being available for sale.

But there still remains much to be done in the matter of economy of fuel. The refuse clinker and ashes usually carted away to the tip contain a considerable percentage of combustible matter. The author has seen upon some gas-works, open hearths for consuming or reducing the tip-refuse, by burning it to as small a bulk as possible. This means a large waste of fuel, which will eventually be realized. It is worthy of note that scarcely any advance has been made in gas-fired boilers.

With reference to the purifying apparatus, hydraulic-power machinery is increasingly popular. In some cases huge purifier lids, weighing 10 tons and upwards, are lifted by means of central rams having the requisite supply-pipe to the cylinder running underneath the bottom of the purifiers. In other cases the pipe is connected through the top of the purifier cover. With this central arrangement, the cover remains elevated over the top of the purifier-box during the operations of emptying and refilling with the purifying material. This, in some cases, is undesirable, especially where the purifying material has to be unloaded at the sides of the purifier-box. In cases where the material is dropped out through openings in the bottom of the purifier-box to a cellar below, the objection is not so great. In other cases the purifier-lid is externally lifted, and suspended over the purifier-box by chains connected to the corners or sides of the covers, according to the design of the framework; the chain being taken up by means of an overhead hydraulic ram. In this case, the purifier cover has usually to be travelled upon a huge carriage, and suspended over an adjoining purifier. Some very useful forms of lifting apparatus have been designed, operated by manual labour; but this is a slow and tedious process, and cannot be regarded with entire satisfaction. Messrs. John Abbot and Co., of Gateshead-on-Tyne, have made a speciality of hydraulic lifting apparatus of every design, and have erected several of the finest and most satisfactory installations in the world. They have also applied to many works hydraulic power for crane purposes, for elevating the purifying material to different floors. Some of the best forms of hydraulic pumping-engines, lifting apparatus, and machinery extant are to be found upon gas-works, for various purposes.

In scrubbers and washers there are shafts, gearing, and machinery, either for working the water-distributing gear, or for revolving plates and discs in connection with the apparatus. Many gas-valves are elaborate pieces of mechanism. There are also several gas-regulating governors, jet photometers, and meters, possessing features of interest, although not coming within the scope of this paper.

Mechanical engineering has a splendid field still in gas-works machinery to prevent waste. One item alone demonstrates this. The large quantity of gas wasted when the retorts are open, both during the charging and discharging of them—although enormously reduced by the substitution of machinery and inclined retorts in lieu of hand stoking—still leaves much to be improved. The quantity of spent lime, which is in many towns a waste product, also demands further inquiry as to its adaptability or suitability for any other purpose or process. There can be little doubt that with the progress of science, what is now termed refuse material will be turned to profitable account. After calcining the spent oxide at the chemical works for the extraction of the sulphur, the huge heaps of material left certainly ought to be further considered. The broken retort material is now being reground by fire-goods manufacturers, and need not be carted away to the tip.

Considering the quantity of fine dust produced from coke, consisting of the best fuel material, it is somewhat suprising that greater attention has not been given to the manufacture of briquettes. Experiments have been made from time to time by the addition of varying quantities of pitch (some 7 or 8 per cent.), and other matter to the dust, but nothing very perfect has as yet been extensively adopted. While coal sludge seems to have made greater strides and with a large amount of success, especially where the fuel has been used for marine purpose, coke dust is regarded as a source of annoyance instead of profit. It has certainly been utilized for asphalting.

The waste water from sulphate of ammonia manufacture deserves consideration. It is now passing away to the extent of millions of tons annually, quite hot. The waste of this hot water should be preventable. Water used for quenching coke is allowed to drain away to waste; containing, as it does, many different elements in solution. An enormous quantity of cyanides in coal gas is also being lost, although efforts are now being made to recover it.

The retort-house is obviously the foundation and commencement of gas-works operations, and specially designed machinery for emptying and filling the retorts first claims consideration. Formerly the larger coal required to be broken was dealt with solely by hand. In works now, where hand stoking continues, the stoker is provided with a sledge hammer to smash up the large lumps of coal. Where a large quantity of cannel coal was used, it was necessary to employ a gang of men for the purpose; and as it was desirable the percentage of cannel should be continuous, this gang took their turns as regularly as the stokers themselves.

Coal-breakers are generally and most desirably placed, where circumstances permit, in the coal-stores, in brick pits covered by suitable iron framing and floor-plates. The breaker is driven by a steam or other engine combined with it, or a separate gas-engine may be used for driving the breaker where available. There are several sizes and types of coal and cannel breakers to suit all classes of large and small cannel, as well as the numerous varieties of common coal. The coal may be brought into the coal-stores by railway waggons on an overhead railway, or by carts or conveyors.

In one of the Birmingham Corporation Gas-Works, of which the author had the superintendence for several years, specially designed steel hopper waggons (Hunt and Shackleford's patent), with sloping ends and two sliding doors underneath, were placed directly over the top of a hopper supplying the coal-breaker, and the contents of a 10-ton truck were emptied directly into the hoppers and coal-breakers below. These waggons were first

* See "JOURNAL," Vol. LXVII., p. 23, and *ante*, p. 127.

adopted by Mr. Charles Hunt, M.Inst.C.E., at the Windsor Street Gas-Works, Birmingham.

When the cannel or coal has been reduced to a suitable size by crushing through the breakers, it falls, together with the smaller pieces which do not require breaking and the dust, into the bottom of the pit in which the elevator runs. It is then carried up to a large overhead hopper placed in the upper portion of the retort-house, on girders spanning between the coal-store and the retort-bench. These elevators consist of malleable iron buckets fitted to a strong detachable link-chain, provided with lugs for fastening the bucket bolts and sliding pieces to. The chain and buckets are guided by a strong latticed iron and steel framing, complete with standards and other attachments for fixing to the coal-breaker floor, and also to the overhead fixed hoppers. The elevators are driven by belting and chain gear, with intermediate counter shaft from the coal-breaker engines. In cases where the coal-stores are only on one side of a retort-house containing through retorts, the coal is conveyed to the hoppers by horizontal conveyors fixed over the retort-bench. Horizontal and slightly inclined conveyors are also extensively used for conveying coal in this way, as well as from the stores, when situated at some distance from the retort-house.

At the present time, there are hundreds of gas-works with stoking machinery installations in operation, the perfection of which leaves scarcely any room for economy by the more recent invention, or re-introduction, of inclined retorts. With machinery, a retort may be discharged and recharged in a few seconds with comparative ease. Manual drawing and charging machines are applicable to small works having an annual consumption of about 2000 tons of coal; but the more comprehensive systems driven by compressed air, or by hydraulic power, are suitable for medium-sized and large works. The present method of carbonizing coal is in small quantities, of from 6 to 8 cwt. perhaps as a maximum, per 20-foot retort. The three systems of charging the retorts at present in existence are hand stoking, manual or power machine stoking, and the inclined system. The system of inclined retorts necessarily requiring little more than elevators and conveyors does not reasonably come within the scope of this paper; and tempting as the subject is, it must be left out of consideration.

Hundreds of stoking machines are now giving entire satisfaction in London and the provinces, as well as on the Continent. By the rapidity of charging, the consequent saving of heat in the retort, and the even distribution of the coal inside the retort, an increased volume of gas per ton is obtained. There is also the more important consideration of a reduction in labour and cost of working. With the aid of machinery, the coal is broken to a regular size, and is evenly charged throughout the entire length of the retort by the chargers. It therefore follows that a greater quantity of coal can be carbonized per retort than is the case with ordinary hand labour. Very important advantages accrue from the foregoing facts, inasmuch as they not only enable more coal to be carbonized per retort, and a greater volume of gas to be produced (due, as stated, to the even deposition of the coal), but there is also a considerable saving effected in capital expenditure on plant, due to the extra manufacture from a given retort area. This saving goes a long way towards recouping the capital expenditure on the machinery.

The two principal systems now in use are the West and the Arrol-Foulis. The machinery designed by Mr. John West has now been in successful operation for about a quarter of a century. Mr. West's manual type of charging-machine consists of a square upright frame on wheels, travelling on tram-lines laid in front of, and parallel to, the retort-bench. The machine is propelled by a hand-wheel and gearing attached to one side of the machine; and on the opposite side there is another hand-wheel and gearing for hoisting and unloading an adjustable coal-hopper from one tier of retorts to any other. The adjustable coal-hopper on the charging-machine receives its supply of coal for a number of retorts from the overhead fixed coal-hoppers, and is free to move vertically between the four uprights of the charging-machine frame; being guided by them, and suspended by chains. A light frame is suspended from the coal-hopper for carrying the charger when it is out of the retort. At the bottom of the hopper, but directly over the charger, is a feeder-box for supplying the charger with coal. The charger consists of a light carriage, running on three wheels, having two semicircular scoops at the bottom. The scoops are arranged to turn over in opposite directions by the twisting of the long driving-rod about half way round in one direction. It will be noticed that this manual charger is designed to charge half the length of the retort at a time, and goes in the retort twice to make a complete charge. A removable platform is used for working the top tiers of retorts. Mr. West's manual drawing machine is similar to the charger. With the manual machinery, 45 retorts can be charged and drawn as regular duty in 45 minutes—and this without causing the men half as much fatigue as the ordinary hand-labour work involves.

The compressed-air system is the one now applied to Mr. West's power machines. After something like seventeen years' use of this power, the excellent working results have fully justified its employment. Cotton and wire-rope driven machines are at work, with excellent results. The ropes are overhead, and are driven by a stationary steam or gas engine, fixed at one end of the retort-house. These engines for the driving of stoking machinery are preferably arranged in a house detached altogether from the retort-house, as it is most undesirable to have such engines working in dust and dirt, when avoidable. After numerous experiments with gas-engines fixed on the machines themselves, it was found undesirable to adopt gas power at all, unless the engines were quite separated from the retort-house; and it was therefore arranged to drive overhead ropes for the system, or to drive an air-compressor for the compressed air system only when arranged in buildings quite removed from the dust and dirt of the retort-house. The air is compressed to the comparatively low pressure of 60 lbs. per square inch, and conveyed to the required machine by a flexible pipe, with connections and gearing so arranged that little, if any, attention is necessary from the attendant.

The time taken for supplying the coal to the charger, and completing the full charge in the retort, averages 30 seconds per retort, or at the rate of (say) 120 retorts per hour. Taking the time from the commencement of a draw to the completion of the last charge, and bringing the machines back into place ready for the successive draw, these machines work 80 retorts per hour. Indeed, this rate has often been exceeded. Before the power machinery was employed, the retorts were charged with 6½ to 7 cwt. of coal, which was carbonized in 4 hrs. 48 min. The power machinery puts in 8 cwt. per retort, which is carbonized in the same time as formerly, and which equals about 16 per cent. increased weight of coal alone.

The power charging machines are fitted with propelling gear, for travelling up and down the retort-house. Each machine has an adjustable coal-hopper, which is raised or lowered to suit the various tiers of retorts, by means of gearing worked by the same motor propelling the machine. The hopper is provided with a feeder-box, for regulating the weight of the charge of coal. The charger which enters the retort is carried in a frame suspended below the hopper, and is driven in, and withdrawn from, the retort by a compressed-air cylinder, rack-and-pinion chain-drum, and chains. The charger consists of a scoop and carriage, containing the apparatus for emptying the coal out of the scoop, and replacing it for a fresh supply. The scoop enters each retort twice for making a complete charge—first turning over in one direction and then in the other, thus throwing the coal towards the right and left hand sides of the retorts respectively, which ensures the charge depositing evenly over the whole base of the retort. The drawing-machines are fitted with travelling and hoisting gear, for raising and lowering the rake-bar frame, carrying the rake bar and head to the several tiers of retorts. They are fitted with compressed air and controlling cylinders, rack and pinion chain drums for the various operations.

The air is conveyed from the receivers by iron pipes to the hose drums, fitted to the girders carrying the overhead coal-hoppers. There is generally a large hose drum, complete with all fittings, for each of the charging and drawing machines. A long length of flexible hose is attached to each of these drums at one end, and at the other end to the machine supplying it. Each drum is provided with a hollow shaft, through which air is supplied; and by an arrangement of gun-metal swivel joints, the air is supplied to the hose on the drums during their revolutions. On each of the hose drum-shafts, a chain drum is keyed; while a chain attached to this leads over pulleys into the retort-house roof, having weights at the other end which rise and fall as the hose is automatically given in and out by the machine as required. The hose leading from the drums to the machines is specially designed for conveying air. It is supported at intervals by suspending brackets and rollers, so that the strain on the hose is very light. The exhausted air assists materially in the ventilation of the retort-house.

The Arrol-Foulis hydraulic stoking machinery has many points of interest, requiring similar coal breaking, conveying, and elevating plant as the machinery already described. The charging-machine obtains its supply from the overhead coal-hopper. A small quantity of coal is dropped in front of the pusher plate, which is then propelled into the retort; the coal being delivered by about half-a-dozen propulsions, beginning from the farthest end of the retort, and receding to the mouth. The apparatus for this work consists of a horizontal slide beam, on which are placed two hydraulic rams—one for the forward movement to the pusher plate, and the other for withdrawing it. Alongside the forward or pushing ram is a turning shaft carrying a series of stoppers, which come into operation as the shaft is revolved, bringing the pusher plate to a stand in the successive positions of its stroke. The coal-feeding gear consists of an open drum divided into segmental compartments, revolving underneath the coal-hopper, and put in motion at regular intervals by means of a hydraulic ram and rack. The action of the drawing-machine is so similar to that of the charger that it need not be described. The working pressure usually adopted for this hydraulic machinery is about 400 lbs. per square inch.

It is sometimes considered that the depreciation of gas-works machinery is necessarily much greater than in other engineering establishments. With proper care and attention, this, however, should not be the case. Every wearable part of any of the machines has to be renewed from time to time, to keep it in working order; so that, although the wear and tear are greater, the machine itself remains in as fair a condition as machinery elsewhere. As an illustration of this, it may be remarked that

the author has worked exhausters of the Jones type (which consisted of two rollers of a figure 8 section, and which were fifty years old) for many years with considerable success and equality of vacuum.

The quantity of dust in a gas-works, especially upon the sidings, and in and about the retort-houses, is very great. The type of locomotive is therefore a consideration. Mr. S. Geoghegan's patent shunting locomotive engine is peculiarly adapted for these conditions for narrow-gauge railways. The working parts of the engine are boxed up on the top of the boiler, and are therefore clear of the liability to be cut by coke dust and grit, as is so often the case when the working parts are under the boiler.

The author considers the foregoing remarks will prove conclusively that rule-of-thumb methods as far as gas-works machinery is concerned are being rapidly superseded by mathematical calculation and design, which to all engineers must be a matter of satisfaction.

GERMAN ASSOCIATION OF GAS AND WATER ENGINEERS.

The Annual General Meeting of the above-named Association has been postponed for a second time (*ante*, pp. 770, 1132), owing to the date selected for the Imperial parliamentary elections falling on one of the days previously chosen for the gathering. The meeting is finally announced to take place in the hall of the Museum at Nuremberg on June 29 and 30 and July 1. The first day will be devoted to the reading and discussion of papers bearing on the gas industry; the second, to papers dealing with water supply; and the third, to private business, and papers left over from the preceding days. The meeting will open with the Inaugural Address of Herr L. Körting, Manager of the Hanover Gas-Works. The reports of the Committees of the Association appointed to investigate the subjects of Settings of Inclined Retorts, Photometry, Heating by Gas, Gas-Meters, Standards for Water-Meters, and Water Statistics, will be presented by the Secretaries of the several Committees. Water gas will be dealt with by three well-known experts—viz., Dr. W. Leybold, of Hamburg, who will speak on "Carburetted Water Gas," Dr. H. Strache, of Vienna, who will illustrate by demonstrations the "Recent Advances in Lighting by Water Gas;" and Dr. H. Bunte, of Carlsruhe, who will offer some "Observations on the Water Gas Question." Herr F. Liebetanz, of Düsseldorf, will read a paper on the "Present and Future Position of Acetylene Lighting;" Herr Utzinger, of Nuremberg, one on "Recent Electric Lighting Installations;" and Herr H. Vogel, of the same town, one on "The Diesel Motor." Herr Niemann, of Dessau, will speak on the terms of "Gasholder Specifications." The report of the Judges in the prize competition for coke-stoves, announced in the "JOURNAL" for Feb. 2, 1897 (p. 231), will be presented to the meeting. Among papers dealing with water supply will be one by Herr Smreker, of Mannheim, on "Natural Filtration;" one on the "Water Supply of Nuremberg," by Herr Wagner, of that town; and one on the "Effect of Variations of Pressure on the Registration of Water-Meters." A demonstration of the properties of liquefied air will be made during the meeting; and various social functions have been organized for July 2 and the evenings of the four preceding days.

THE DECOMPOSITION OF GAS OIL, PHENOL, AND CREOSOTE BY HEAT.

The researches of which we are about to give a summarized account were carried out by Dr. E. Müller at the Chemical-Techical Institute at Carlsruhe. They were undertaken at the suggestion of Dr. H. Bunte, and form a sequel to the researches conducted by Dr. F. Haber and Herren Samoylowicz and Oechelhaeuser on the "Decomposition of Hydrocarbons by Heat."* The gas oil on which certain of the researches were made, is of the class produced in Saxony and Thuringia by the distillation of brown coals and shales. Such oil is only occasionally offered for sale in this country; but in many respects it resembles the Scotch gas oils, and in some points blast-furnace oil. Dr. Müller's methods of analysis and investigation are well worthy of record, as a guide to future investigators, even though his results are of less general interest than they would have been had he made his experiments on Russian or Scotch oils. A full account of his researches has been published in four recent numbers of the "Journal für Gasbeleuchtung," and from it the following abstract-translation has been prepared.

Introduction.

Very varied liquid and gaseous products and solid residues are obtained by the dry distillation or decomposition by heat of coals, fats, resins, paraffin oils, petroleum and similar organic substances. The most important gaseous product of such a process is coal gas; but oil gas also has a wide application for lighting, under special conditions, and for the enrichment of coal gas. Oil gas can be compressed under a pressure of 10 atmospheres with comparatively slight detriment to its illuminating power; and since it contains four or five times the amount of heavy hydrocarbons which is found in coal gas, it has about four times the illuminating value of the latter. In Germany, oil gas is made almost solely from the heavy oils of the paraffin-oil industry, and these oils are known commercially as gas oil. They are reddish brown in colour, but have a blue fluorescence and hence are frequently called blue oils. Their specific gravity lies between ·88 and ·90; and they flash between 212° and 248° Fahr. They begin to boil about 410° Fahr.; 5 to 10 per cent. distils over under 482° Fahr.; 40 to 60 per cent. under 572° Fahr.; 40 per cent. under 680° Fahr.; and above the latter temperature partial decomposition sets in. From 20 to 50 per cent. of the oil is dissolved by concentrated sulphuric acid; and from 1 to 2 per cent. of creosote is generally found in it. The oils are valued for gas making by tests made on a fairly large scale in experimental works. Hirzel has proposed as a suitable standard oil one of which 100 kilogrammes yield 60 cubic metres of gas, which has an illuminating power of 7·5 German standard candles at an hourly consumption of 35 litres. The product of the yield in cubic metres and the candle-power divided by 35 gives a number which expresses the value of an oil. For the above standard this number is 12·86; and no oil suitable for gas making should give a lower value than this figure. [If the yield is expressed in cubic feet per ton of oil, and the illuminating power in English candles at the above rate of consumption (= 1·236 cubic feet per hour), the product of yield and candle-power divided by 1·236 gives a result, which, if divided by the constant 10667, gives the value of the oil on Hirzel's scale. His standard oil (value = 12·86) yields 21,530 cubic feet of gas per ton; and the illuminating power of the gas at a consumption of 1·236 cubic feet per hour is 7·875 English candles. Thus—

$$\frac{21530 \times 7{\cdot}875}{1{\cdot}236 \times 10667} = 12\,86]$$

Though every oil suitable for gas making should show a higher value than 12·86, yet in order to apply this rule fairly, the yield of gas from which the value is computed should be approximately 21,530 cubic feet per ton. This precaution is necessary because the product of yield and candle-power is not constant for the same oil when the yield varies considerably. In some cases the candle-power increases with the yield up to a certain point, and then falls off.

It has been remarked that the results of enriching a poor gas-making oil with a richer one are very anomalous. Rosenthal found the admixture of an oil of the standard value with one of 36·8 per cent. higher value depressed the gas-making value 11·5 per cent. below that of the standard oil. This result was no doubt due to the fact that the temperatures of decomposition of the components of the two oils showed great divergence, so that the gas produced from one oil suffered secondary decomposition while the other oil was being gasified. The composition of gas oil has not yet been completely made out; but the chief constituents are aliphatic hydrocarbons and hydrogenized aromatic hydrocarbons, and minor constituents are creosote and paraffin. The uncertainty as to the precise composition of the oil makes it a matter of difficulty to draw conclusions as to the course of the gasification from a study of the products of decomposition. Useful conclusions must easily be drawn from observations on the decomposition of members of series of hydrocarbons which are largely represented in gas oil. Such observations have been made by Haber, Samoylowicz, and Oechelhaeuser on hexane and trimethylethylene and recorded in the papers already referred to. Berthelot, Thorpe, and Young had made similar researches earlier.

The results of old and recent researches lead to the conclusion that aliphatic or non-aromatic hydrocarbons, of which the molecule contains more than two carbon atoms, decompose into smaller hydrocarbon molecules. Scission of the molecule occurs at low temperatures as a rule in the middle; but at high temperatures, near one end of the chain. Hydrogen is split off only if the temperature of decomposition is very high. The lowest members of the methane series cannot yield by scission two simple hydrocarbons; and their pyrogenous decomposition displays complex relations, which need further investigation. In all cases of pyrogenous decomposition, some acetylene is produced; and from it arise, by secondary reactions, benzene and higher aromatic products, which, however, never constitute the chief products of the decomposition; and hence attempts to form benzene in this manner commercially have so far been unsuccessful. In proof of this statement may be cited the cracking process, by which Breitenlohner and Vohl originally claimed to secure a large yield of aromatic hydrocarbons, and the researches of Liebermann and Burg, Salzmann and Wichelhaus, Atterberg and Letny, none of which have proved successful in securing a considerable yield of benzene and the allied hydrocarbons. No practical success has been achieved in this direction, even with Russian petroleum, which, on account of its large content of naphthenes, should be specially suitable for conversion to benzene and its homologues. Dvorkovitz, however, has stated that a ton of petroleum will yield 920 gallons of tar, containing 298 gallons of benzene, in addition to 167,577 cubic feet of gas of 60·3-candle power; and according

* See "JOURNAL," Vol. LXVIII., pp. 367, 458, 501; and Vol. LXIX., pp. 349, 409, 476, 528, 589.

to Rednew, the tar from the Kazan oil-gas works contains 10 to 12 per cent. of benzoline and benzene, and 5 per cent. of naphthalene.

The Saxony-Thuringian gas oil contains, in addition to hydrocarbons, oxygenated compounds such as phenol and the cresols; and the present investigations aim at the observation of the behaviour of these compounds on gasification. Vohl observed in 1864 that such compounds were found in the crude oil produced by the dry distillation of lignites and bituminous shales. He pointed out that these compounds passed into the heavier oils when the crude oil was worked up for the production of lighting oil, and rendered the heavy oils unsuitable for lighting purposes, since, in addition to possessing an objectionable and penetrating odour, the compounds hardened the wick and caused discoloration of the oil. Now a burning oil lamp is a gas-works in miniature; and the same compounds may be expected to be injurious in gas making. Experience has indeed proved that oils containing much creosote have a higher value for gas making after they have been treated with soda-lye for the removal of the creosote. Scheithauer states that a ton of creosote yields only 4990 cubic feet of gas having an illuminating power of 6·23 candles (presumably at a consumption of 35 litres or 1·236 cubic feet per hour), and its injurious effect on a gas oil must, therefore, be most marked. It does not appear to have been used for gas making; but the crude soda solution of creosote has, according to Ramdohr, been tried, and notwithstanding its cheapness, the trials were discontinued.

These practical results are, however, opposed to the indications of a great number of observations, according to which large quantities of benzene, which is a powerful illuminant, are produced by the pyrogenous dissociation of phenol. Professor Watson Smith has been in the habit of obtaining benzene free from thiophene by passing phenol through a red-hot glass tube packed with iron filings or carbon.* The following equation represents the action occurring under the circumstances:—

$$\underset{\text{(phenol)}}{C_6H_5OH} + \underset{\text{(carbon)}}{C} = \underset{\text{(benzene)}}{C_6H_6} + \underset{\text{(carbonic oxide)}}{CO}$$

The same author says that the cresols similarly yield toluene; and he also found a like decomposition occur when phenol or creosote vapours were passed along with hydrogen through tubes packed with pumice. Professor Vivian B. Lewes takes up the same position. On gasifying in the ordinary oil gas apparatus blast-furnace oil and coke-oven oil, which contain about 40 per cent. of paraffin oil, creosote, phenol, and compounds of the pyridine series, he obtained a considerable yield of oil gas which was fit for use. But on employing narrow tubes packed with coke, the illuminating power of the gas was increased by 20 per cent. The conversion of phenol and cresol to benzene and ethylene, to which the increased illuminating power is due, might be explained by the following equations:—

(1) $$\underset{\text{(phenol)}}{C_6H_5OH} + \underset{\text{(carbon)}}{C} = \underset{\text{(benzene)}}{C_6H_6} + \underset{\text{(carbonic oxide)}}{CO}$$

(2) $$\underset{\text{(cresol)}}{C_6H_4OH\,CH_3} + \underset{\text{(carbon)}}{C} = \underset{\text{(toluene)}}{C_6H_5CH_3} + \underset{\text{(carbonic oxide)}}{CO}$$

(3) $$\underset{\text{(toluene)}}{\left.\begin{matrix}C_6H_5CH_3\\C_6H_5CH_3\end{matrix}\right\}} = \underset{\text{(benzene)}}{\left\{\begin{matrix}C_6H_6\\C_6H_6\end{matrix}\right.} + \underset{\text{(ethylene)}}{C_2H_4}$$

These equations are, however, merely conjectures, as it is impossible to draw reliable conclusions as to the course of the change of single constituents of a highly complex gaseous mixture from the results of a gasification of the mixture.

Confirmation of the view that phenol on heating is converted to benzene appears to be afforded by Herr Kramers, who, on leading a quantity of crystallized phenol through a galvanized gas-pipe heated to bright redness obtained 50 per cent. of undecomposed phenol, 20 per cent. of benzene, 10 per cent. of naphthalene, 17½ per cent. of asphalt, and 2½ per cent. of toluene and other products. But since a galvanized pipe was used, it appears possible that the zinc coating on the pipe aided the reduction of the phenol to benzene. In order to avoid this risk, he repeated his experiment by passing 250 grammes of phenol through a glass tube, and obtained a tar, of which 20 c.c. was distilled off as a first fraction, and agitated with potash lye. He thus obtained 2 c.c. of a volatile oil; and the presence of benzene in it was proved by conversion to aniline. But this qualitative recognition of benzene with which Kramers was satisfied, points to there being an immense difference in the yield of benzene compared with that obtained in his first experiment; and his researches do not clear up the matter in the least. Finally Herr von Hofmann sought in vain for benzene in the tar formed during the gasification of phenol which was passed through a red-hot gun barrel. The negative results do not, however, altogether preclude the possibility of benzene being formed by the gasification of phenol; for in virtue of its high vapour tension, the benzene might be carried on in the gaseous product—just as in the case of coal-gas manufacture, 94 per cent. of the benzene produced is found in the gas, and only 6 per cent. in the tar.

A review of the researches of Messrs. Watson Smith, Lewes, Kramers, and Hofmann leaves it doubtful if phenol gasified alone yields the same products as when it is gasified in the presence of aliphatic hydrocarbons, such as occur with it in gas oil. A solution of the question can only be arrived at by gasifying gas oil freed from phenol and creosote, and phenol, and creosote, both alone and in mixtures with one another. In an experimental apparatus designed to aid the solution of the question, it became necessary to provide for tracing the formation of aromatic substances and of benzene in particular, and for detecting them in a manner which will be described later.

The Apparatus Employed.

The apparatus employed was substantially the same throughout these researches. It consisted of five portions—viz., (1) A feeding appliance; (2) a gasification chamber; (3) a tar condenser; (4) absorption vessels; and (5) a gasholder.

The feeding appliance for liquids, such as gas oil, creosote, and their mixtures, consisted of a tube graduated in cubic centimetres so that the quantity of liquid gasified could be read off at any time. For phenol it was necessary to use a hot-water jacketed funnel, in order to keep the phenol in the liquid state. The supply of liquid could be cut off entirely by means of a stop-cock on the tube which led from the feeding appliance to the gasification chamber. The supply was regulated by means of a screw-clip on the flexible tube which served to connect the feeding appliance with the horizontal tube which led to the gasification chamber. The latter tube projected into the chamber for a distance of about 1·7 inches, and had a drawn-out orifice. The gasification chamber consisted of an iron tube nearly 4 feet long and 0·5 inch in diameter. The inlet end of this tube projected 16 inches, and the outlet end 6 inches, beyond the furnace used for heating, so that the heated portion of the tube was 26 inches long. The furnace had 20 burners; but at the inlet end only alternate burners were lighted for the first half of the length of the tube, so that in all 15 burners only were used. This arrangement provided for a gradual accession of heat to the entering liquid, and the final application thereto of an uniformly high temperature. The burners played directly on the tube. The pressure of the gas supply was controlled by a governor. The furnace sloped from the oil inlet to the gas outlet at an angle of 3 in 100. The furnace was lighted for half-an-hour before each experiment. The temperature was determined by the melting of alloys and salts enclosed in difficultly fusible glass, and was always kept between 1292° and 1470° Fahr. This range of temperature is that practically used in oil-gas manufacture. The ends of the iron tube were closed by caoutchouc plugs; and in order to protect these from the heat, lead tubing, through which water circulated, was coiled round the projecting ends of the iron tube. This arrangement also cooled the outflowing gas, so that the glass tube which connected the gasification chamber with the tar condenser experienced but little heating. The tube was bent downwards, and passed into the bulb of a 150 c.c. fractionating or Wurtz flask. Its lower end was drawn out to a narrow orifice. The flask was immersed in a freezing mixture of ice and salt. The gas passed from the flask through its lateral exit tube which was bent downwards and prolonged so that it reached nearly to the bottom of a glass cylinder 12 inches high and 2 inches wide. This cylinder contained 24 perforated metal discs, through which the inlet tube passed. The discs had numerous perforations, and extended to the walls of the cylinder. The holes in adjacent discs were set out of line, so that the gas was forced to pursue a circuitous course up the tower. The flask and the tower constituted the tar condensing apparatus, and served their purpose so well that the gas issuing from the tower was, in nearly all cases, almost colourless, and had been deprived of all particles mechanically suspended in it.

Next followed absorption vessels, of which the first were for the estimation of acetylene. These consisted of five Muenke's gas-washing bottles, of which the first three were charged with concentrated ammoniacal solution of silver nitrate, the fourth with sulphuric acid of specific gravity 1·53, and the fifth with sulphuric acid of specific gravity 1·116. These last two bottles were cooled by means of ice, as was also the apparatus for the absorption of benzene, which will be described later, with the exception of a Winkler's worm charged with paraffin oil, which served chiefly to indicate the speed of gasification. From the absorption vessels the gas passed into a glass globe of about 2·12 cubic feet capacity, which served as the gasholder. Through the stopper of the globe passed the inlet tube, a thermometer, and an outlet tube which extended from near the base of the globe. The water flowed from the globe through this tube to a pressure-regulating bottle, from which it overflowed into a flask. At the conclusion of each test, the pressure in the globe and the pressure-regulating bottle was brought up to that of the atmosphere by the admission of water; and when the temperature in the globe was equal to that of the room, the volume of gas in the globe was found by weighing the latter, the weight of which, when filled with water, had been previously ascertained. In order to avoid loss of certain constituents of the gas by absorption, the same confining water was used in all the experiments, and it was saturated in the first instance with gas made in preliminary trials of the apparatus.

(*To be continued.*)

* "Journal of the Society of Chemical Industry," 1890, p. 447.

The Acetylene Exhibition at the Imperial Institute.—The official opening of this exhibition, which was to have taken place on the 1st inst., has been postponed till the 15th. Appliances not at work, however, are now on view in the North Gallery of the Imperial Institute.

BRITISH ASSOCIATION OF WATER-WORKS ENGINEERS.

We continue to-day our report of the proceedings at the recent meeting of the above Association by giving, in abbreviated form, the first paper read and the discussion which followed. It was by Mr. C. H. PRIESTLEY (Cardiff), and was entitled—

EXTENSION OF FILTER-BEDS, &c., SERVICE RESERVOIR, AND WATER TOWER, CARDIFF.

It was in July, 1896, that the author was instructed to report on the question of constructing additional filters at the Heath and a new high-level service reservoir at Penylan. At that time there were at the Heath three filter-beds, with pure-water service reservoir, inlet chambers, measuring chambers, and sufficient land for very considerable extensions; being part of a large scheme for an entirely new supply to the borough which was designed and carried out by Mr. J. A. B. Williams. In his report, the author recommended the construction of three additional filter-beds at once; and also the erection of sand-washing apparatus, foreman's cottage and office, large tool-shed, and mess-room. Regarding the reservoir, he explained that one section of the high-level service is taken from a balancing reservoir and small service reservoir at Rhubina; but he decided that it would be an advantage to have an altogether independent reservoir near a part of the district which is likely to be largely built upon in the future. A suitable site presented itself on Penylan Hill, which has an elevation of 210 feet above Ordnance datum, and from which nearly the whole of this section of the high-level district could be supplied. The author proposed to build two service reservoirs, each to contain 3 million gallons of water. At present the second reservoir will not be required; but he advised that the land should be acquired for both. For the supply of the houses in the immediate neighbourhood on the top of the hill, a small water-tower would be required; and he also recommended that a caretaker's house should be erected. An approximate estimate for the works was as follows—The Heath: Three filter-beds at £3500 each, £10,500; foreman's cottage, £400; new sand-washing apparatus, £400; extension of cast-iron mains, &c., £850; boundary wall and fences, £750—total, £12,900. Penylan: Six acres of land, at £500 per acre, £3000; one reservoir to be built now, £9000; portion of second reservoir, £500; water-tower, £750; turncock's house, £400; cast-iron mains, &c., £500; boundary wall and fences, £750—total, £14,900. The Water Committee ordered the additional filters to be taken in hand first, and then the service reservoir.

The new filter-beds have been placed alongside the former beds in accordance with the original design, and to a certain extent it was necessary to carry out the new work on much the same lines as the existing beds; but the author was able to introduce several improvements and modifications which the experience of ten years' working suggested. The size of each bed is 200 ft. by 75 ft. by 7 ft. 3 in. deep; and each is calculated to filter a million gallons of water per 24 hours, allowing 2·78 gallons per superficial foot of filtering area per hour. The floors of the beds are constructed of concrete in two layers 8 inches and 4 inches thick respectively; the 8-inch layer of 5 to 1 concrete and the 4-inch top layer of 4 to 1 concrete—the surface being rendered and trowel smoothed. The side, end, and division walls are built of brickwork and masonry, with concrete backing and hearting (5 to 1) in a very substantial manner. The width of the division walls at the bottom is 5 ft. 2 in., and at the top 3 ft. 6 in.; the side and end walls are 3 ft. 4 in. at the bottom, and 2 ft. 6 in. at the top. The portion below the sand-level is built with the best Staffordshire blue and brindle bricks (selected blue-brick facing), backed with cement concrete 5 to 1; and above the sand-level, the walls are composed of random coursed masonry of Newbridge stone, with concrete backing as before. A main drain with semi-circular invert was constructed in the centre of each bed, lined with a single ring of radiated brindle brick in cement, coped with a course of Staffordshire blue brick set in cement (all headers) finished flush with the floor. The whole of the floor in each filter was covered with lateral drains of wire-cut red bricks, with two grooves on the underside of each, laid flat to form continuous channels and close together. A longitudinal drain was formed on each side of the filters, covered with blue Staffordshire tiles, and communicating with 4-inch stoneware ventilating-pipes built in the walls of each bed.

The providing and laying in of the filtering material was not included in the general contract, as the author believed it would be much more satisfactory to procure the material and (as all the necessary appliances were upon the ground) to screen and wash it under the superintendence of the Corporation foreman; thus ensuring clean material to commence with. The filtering medium was composed as follows: 6 inches of broken stone or Portsmouth shingle, 2 inches to ¾ inch in gauge; 3 inches of gravel, ¾ to ⅜ inch; 6 inches of gravel, ⅜ to about ⅛ inch; 15 inches of sand, and a top layer of 6 inches of fine sand, containing at least 10 per cent. that would pass through a sieve of 4900 holes to the square inch. Over 6000 tons of filtering material was used, the cost of which when placed in the beds, after thorough screening and washing, worked out to an average price of about 10s. per cubic yard.

The water is taken into the filters from a 36-inch cast-iron main running alongside each bed to the inlet chambers, which are built at the north end of each filter with brindle brick, faced inside with radiated blue brick. The chamber wall is 18 inches thick set, and pointed with cement mortar. The floor stones are of Newbridge stone setts 12 inches thick, dressed on face, set in cement and grouted and pointed, laid to drain to a sump 9 inches deep, with a 4-inch emptying valve communicating with the main drain. The lower end of each main drain discharges into a small semi-circular outlet well in each filter, into which the ends of the cast-iron draw-off main and the scouring-pipes are inserted. The outside face of the wall of each outlet well is built in masonry of the same description as the upper part of the walls of the filters. The inside of the wall is faced with the best white enamelled glazed radiated bricks, set in cement, and backed with brindle bricks; and the floor is also paved with white enamelled glazed bricks, set in and pointed with cement mortar. The valve and weir chambers are constructed with brindle brick, faced with blue brick, and arched over with radiated blue bricks formed to the manhole boxes. Sillstones of Forest of Dean stone, ashlar dressed, are provided with wrought-iron and gun-metal weir-plates attached for measuring the discharge from each filter. The author has designed the outlets of the filters so as to maintain an absolutely steady rate of filtration, combined with simplicity of working; the form of the work permitting the older beds to be altered to match at a minimum cost. In what is called the weir chamber is fixed an overflow sill (or gauge plate) 3 ft. 10½ in. wide, with knife-edge and a free overfall. To ensure the even working of the filter, the discharge over this sill must be constant; and to indicate if it is so, a float is provided and carried above the ground-level in a 3-inch cast-iron pipe.

The adjustment of the filtering head is effected by causing the filter to deliver into the outlet chamber; and from thence it is drawn off into the valve chamber through an 18 inch valve. On starting the filter by gradually opening the valve, the prescribed level of water over the weir is readily obtained and indicated by the float; the excess of head being absorbed in overcoming the friction through the aperture of the valve, while the difference between the levels of the water in the filter and the outlet chamber gives the filtration head required for the predetermined flow. As the deposit on the sand takes place, the resistance to the passage of the water increases; and the filtering head must be increased by lowering the surface of the water in the outlet chamber. This is effected by slightly opening the sluice valve, and thereby maintaining the float at its predetermined level. On completion of each filter, and before the filtering material was put in, it was thoroughly tested by being filled with water up to the overflow-level, and in each case the beds were found to be perfectly watertight.

Separate contracts were made for the supply of the cast-iron mains, valves, &c.; but the general contractor had to lay, fix, and joint them. The pipes, varying in size from 36 inches to 6 inches diameter, were not allowed to be rolled into the trenches; but all, excepting the small sizes, were lowered by pulley blocks from shear legs. The jointing was done in the following manner: The joint in each size of pipe was half filled with soft blue lead of round section, caulked in cold ring by ring; and the remainder of the joint run with pig lead, well staved and set up into the sockets. The flange joints were made with sheet wire rubber insertion, bolted up, and made watertight.

Nearly 23,000 cubic yards of excavation was required for the three filter-beds; and the contractor very wisely decided to employ a steam-navvy for this work. The filters adjoin the Rhymney Railway; and a siding was put in which enabled the contractor to bring his material on to the ground much more economically than by horse haulage. Owing to the exceptional facilities for the removal and disposal of the surplus excavation, the author believed it would be advantageous to complete the excavation for two more filter-beds and another service reservoir; and the Committee accepted the offer of the contractor to undertake this work at the low price of 1s. 2d. per cubic yard (compared with 1s. 4d. for the first contract) for above 30,000 additional cubic yards of excavation.

Some information having been given as to the qualities and tests applied to the materials used, the author said the amount of the contract was £10,114, which included £250 for extra works. This sum has not been exceeded; so that the work was completed slightly under the tendered price. The contractor has to maintain everything in good order for six months after completion. At the time the paper was written, part of the filling of the third bed with filtering material was not quite completed; but the author has calculated what remains to be done, which, together with all the payments made, will amount to £13,750, against £12,900—the preliminary estimate.

Coming to the Penylan service reservoir and water-tower, the author said his estimate of the price at which land might be available on Penylan Hill was much exceeded; the Corporation having to pay £5000 for the 6 acres required. The reservoir was designed to hold 3 million gallons, being 315 feet long by 130 feet wide and 12 feet deep; sufficient land being reserved for a reservoir of similar capacity to be constructed alongside when necessity arises. At the time the author prepared the paper, little more than the excavations had been proceeded with; delay having occurred in letting the contract. The labour members of the Town Council were anxious that the work should be done by the Corporation, and under his (the author's) superintendence. It is well known, however, that an engineer in the employ of a Corporation cannot get the same amount of work out of workmen that a contractor can.

The floor of the reservoir is to be constructed in Portland

cement concrete 12 inches thick in two layers of 6 inches each; the concrete being taken to greater depths where necessary for the foundations of walls and around the scour-pipes, &c., as well as in any soft places which may appear. The concrete will be covered with British asphalte in two ½-inch layers; and a skirting of asphalte is to be formed around the reservoir 12 inches high, and tucked into the joints of the brickwork in the walls. The reservoir walls will be 6 feet thick at the bottom, and 2 ft. 3 in. thick at the top, constructed of brickwork in cement mortar and concrete—the inner portion below the top water-level being built in brickwork 9 inches and 14 inches thick alternately, faced throughout with the best Staffordshire blue bricks (except where covered with asphalte); the remainder of brindle bricks, backed with cement concrete. The top 2 ft. 6 in. of the wall is to be wholly of brickwork, faced on both sides with Staffordshire blue bricks. The walls will be coped with Forest stone 2 ft. 9 in. wide and 8 inches thick.

The foundations for the water-tower are carried down 12 feet below the surface of the ground, and with a cement concrete bed 3 feet thick, except in the centre of the building, where the meter, valves, and pipes are situate. The tower is to be carried up to a height of 53 feet above ground-level; the bottom of the tank being 40 feet above ground-level—a sufficient height to supply all the surrounding buildings which are above the level of the top water of the reservoir. The walls below ground-level are to be 2 ft. 7½ in. wide, built of good stock brickwork. From the ground-level, where the walls are 2 ft. 3½ in. thick, they diminish to 14 in. at the top; the inside dimensions of the tower being 15 ft. 9 in. at the ground-level, and 13 ft. 6 in. at the top below the tank. The water-tank will be carried on steel girders, with concrete arches, resting on padstones of the hardest Newbridge stone; and it will have a capacity of 14,000 gallons. The reservoir keeper's house was also described. The contract for this section of the work amounted to £9730.

The following is a *résumé* of the discussion.

Mr. William Watts (Sheffield) drew attention to the statement that 10 per cent. of the upper layer of sand in the filters was so fine that it would pass through a mesh of 4900 holes to the square inch—that was the square of 70. It seemed to him that material so fine as this was nothing more than dust; and he was afraid that water in motion would disturb it, and carry it away. At all events, he felt sure that in the process of washing these fine particles would certainly be lost, and would have to be replaced from time to time. As to the use of a steam-navvy, he said that for years he had worked one; and his experience was that, although it did a great deal more than men were capable of doing in the time, the cheapness was only apparent. He could never get it to excavate the material at much less than 1s. 1d. to 1s. 1½d. per cubic yard. In excavating for a reservoir, the area was confined, and every few days, unless specially well favoured, the steam-navvy had to be run back again; and it was here that the additional expense came in. He had offered the men premiums if they would run it back in a certain time; and he had also let the work of running it back, and getting it into position by Monday morning. He found he could never get it back for a distance of (say) 200 yards under £7. With this £7, *plus* the working expenses and the interest on the machine, his experience was that there was not a great saving in working a steam navvy. Certainly, with so small a quantity as 23,000 cubic yards, had he been the contractor, he thought he should have kept the steam-navvy off the work. Of course, much depended on the nature of the ground. As to the punning of concrete, he was altogether opposed to it. Punned concrete—especially for a water-tight core—was never so good as a sloddy concrete. He was not at one with the author in reference to work conducted by administration. A good deal depended on how the men were handled. If engineers made themselves worth serving, they would find the men would be faithful to them. There was no reason why they should not let such work as the stone breaking at the crusher and mixing concrete at the top of a trench; but it must be dealt with at the bottom by day work, under a thoroughly trustworthy inspector.

Mr. W. G. Peirce (Richmond) asked the author to give the price paid per hour to the workmen. Without this information, they could not make comparisons, as there was a great difference in the price paid for labour in different parts of the country. At Richmond, they paid good ground men 6½d. per hour; while in the case of work recently carried out in another part of the country, the price was 4d. per hour. At Richmond the men worked 54½ hours per week, and were paid time-and-a-half for overtime.

Mr. D. M. F. Gaskin (Liverpool) asked if the Penylan reservoir, which was to cost £9000, and would have a capacity of 3 million gallons, was to be covered or not. Referring to an incidental allusion by the author to a tintometer, he described one which he had recently seen, and by which the colour of water could be determined at depths of 3 to 5 feet. He expressed the opinion that the instrument was absolutely accurate.

Mr. F. J. Bancroft (Hull) noticed that the author had allowed for the passage of 2·78 gallons of water per superficial foot of filtering area per hour. It seemed to him that this quantity was rather excessive; and it exceeded any one of the London Companies. The lowest was the West Middlesex Company, who passed 1·7 gallons per foot per hour; the highest was the New River Company with $2\frac{9}{16}$ gallons per hour. The quantity of water per hour that a filter would pass was a most important matter, because latterly water had become subject to bacterial examinations, which revealed that the efficiency of an artificial filter depended upon the microbic action upon the gelatinous tissue that formed on the top of the sand of the filter. They could therefore readily understand that the filters that were least frequently cleaned passed the best water both chemically and bacterially, provided the sand was of sufficient thickness. The passage of water through 10 feet of sand was better than its passage along 10 miles of river. So efficiently did the layer of sand filter the water, that they found, in the case of the Metropolitan water in March last, 3180 microbes per cubic centimetre in raw river water reduced to 12 microbes after filtration—representing a filtration efficiency of 99·6 per cent. It was therefore most important that the filtration should be slow. He noticed that the author found the filter-beds, with concrete bottoms, perfectly watertight. He should like to know the nature of the ground on which they were constructed, as, in the case of the service reservoir, Mr. Priestley considered it necessary to cover the concrete floor with an inch of asphalte. As to the laying of the mains, he asked the depth of the sockets of the pipes jointed as described. He was in agreement with Mr. Watts on the question of punning concrete; but as to municipal as opposed to contract work, he did not think they could lay down any hard-and-fast lines.

Mr. W. Jones (Pontypridd) was very much struck with the price paid for the land for the reservoirs. At Pontypridd they had been compelled, from force of circumstances, to construct a large reservoir, for 200 million gallons, in a coal-field, where they had had to deal with both the owners of the surface and of the minerals underneath. But notwithstanding this the price had not come up to that mentioned by the author. Owing, too, to the cost of land, and the difficulties surrounding purchase, they had had to take into consideration some other method of filtering the water. Mr. Priestley spent £3500 in constructing a filter-bed to deal with only 1 million gallons of water per 24 hours; but at Pontypridd they had laid down a plant, at a cost of £1500, to deal with 1½ million gallons per hour—the results being very satisfactory.

Mr. J. Shaw (Boston) could not understand what kind of sand-washer Mr. Priestley used, as, in his opinion, the 10 per cent. of fine sand in the top layer of the filter-beds would go away with the water. He (Mr. Shaw) used a much coarser sand than this, but somewhat finer than he had been accustomed to of late years; and the difficulty he found with it was that, after a scum formed on the top, and it became dirty, when the water was turned on to it, the whole of the fine sand disappeared, and left nothing but the coarse. He believed a fairly coarse sand worked nearly, if not quite, as well after it had been in use four or five days as a very fine sand. The method he adopted for measuring the water passing through the filters was to shut off the inlet for a few minutes, and watch, with a good gauge, how long it took to go down ½ inch. He agreed with Mr. Watts that walls made with very wet concrete stood best. As to administration or contract work, Mr. Watts had been more favoured than he had been in coming across a good class of men. He mentioned an instance in which he required a pipe trench opened; and he came to the conclusion that the value of the work was about 1s. a yard. He offered the work to some men; but they wanted 1s. 1d. A contractor undertook it for 11½d. per yard; and the men then took it from the contractor for 10d.

Mr. Price (Worcester) criticized the author's gauging arrangements at the filter-beds, and expressed the opinion that provision should be made for gauging the water both as it went in and out of the beds. His experience had convinced him that the use of very fine sand was wasteful.

Mr. H. Ashton Hill (South Staffordshire Water Company) was also curious to know why Mr. Priestley covered the floor of the service reservoir, which was 12 inches thick, with an inch of asphalte; while in the case of the filter-beds, he depended on the concrete—presumably unrendered. The reservoir was 12 feet deep; and the question was at what depth did Mr. Priestley consider it would be watertight, as he only proposed to carry the asphalte a foot up the sides. He (Mr. Hill) had heard many engineers say that they could not make concrete watertight. Another point was as to why the reservoir was only made 12 feet deep? It was to be an open one; and it was generally understood that the deeper the water, the better was the quality maintained. The price paid for excavation per cubic yard was no doubt low; but he (Mr. Hill) had carried out some excavation in connection with a reservoir—50,000 cubic yards in gravel—for 8½d. per cubic yard. This was done by agricultural machinery; and he believed it was the first time the system had been used for the purpose in this country. He employed a cultivator and four traction engines—a pair on either side of the reservoir. The cultivator was drawn over, and was followed by a scoop, which took out rather more than a ton of gravel at a time. Alluding to the cost of the water-tower, he suggested to the author that it would perhaps have been cheaper to have had an engine and boiler—a pulsometer or something of that sort—to supply the small district to be served by the tower.

Mr. F. Griffith (Leicester) pointed out that the author only required 15,000 superficial feet of filter to deal with one million gallons per twenty-four hours. His own experience was that this rate of filtration was rather excessive; being about 600 gallons

per square yard. The filtration at Leicester, and in the case of many other water-works, did not reach more than 300 gallons per square yard. It was a well-known fact that the slower the filtration, the better opportunity the water had of cleansing itself. But, of course, different waters required different treatment. The author had not given them any evidence of the chemical quality of the water treated at the rate mentioned.

Mr. W. INGHAM (Torquay) thought it was pretty well understood that one-third of an acre would filter a million gallons of water fairly well; and the approximate cost per square yard would be £2 2s. He found the cost of the author's service reservoir worked out to £3 per 1000 gallons. He compared this with the cost of reservoirs constructed at Torquay some years ago. A 50,000-gallon reservoir, 9 feet deep, cost £4 12s. per 1000 gallons; a 500,000-gallon one (which he admitted was built in rather an inferior manner), only cost 14s. 9d.; a 1½-million gallon one, 10 feet deep, £1 12s. 8d.; a 2-million gallon one, 18 feet deep, £1 19s. 4d.; and a 500,000-gallon one, 8 feet deep and covered, £2 6s. Having commented on some of the prices paid for the materials used in the work, he said it was a singular fact that gas engineers (who were compelled to make their tanks round) built the walls of much less thickness than they did for water reservoirs. He had been comparing the cost of Mr. Priestley's reservoir with what it would cost if made circular. He found that the difference in the length of the walls of the reservoir described and a circular one would be 173 feet; and the cost per lineal foot being £3 4s., a saving of £553 would accrue by making it circular. Why water engineers built oblong tanks instead of circular ones, he could not understand.

The PRESIDENT said that, on the first blush, 2·78 gallons of water per superficial foot of filtering area per hour seemed a large quantity; but, judging from the source of supply, one would conclude that the necessity for filtration was due simply to the occurrence of peaty matter in the water. He was also afraid that Mr. Priestley would have rather a bad time from using sand passing through such exceedingly fine sieves. He congratulated him upon having abandoned the old method of jointing pipes, and mentioned that he himself had not used yarn joints for the last fifteen years. It was perfectly useless discussing the point as to the cost of excavation, as they did not know the character of the soil. As to the question of circular reservoirs compared with rectangular ones, capacity for capacity, the former were the cheaper. In connection with his works, they had a circular reservoir with a depth of 10 ft. 6 in. of water; and the walls were 2 ft. 3 in. in thickness from top to bottom, while Mr. Priestley had had to adopt 2 ft. 3 in. at the top and 6 feet at the bottom. This circular reservoir had been absolutely watertight from the day it was made.

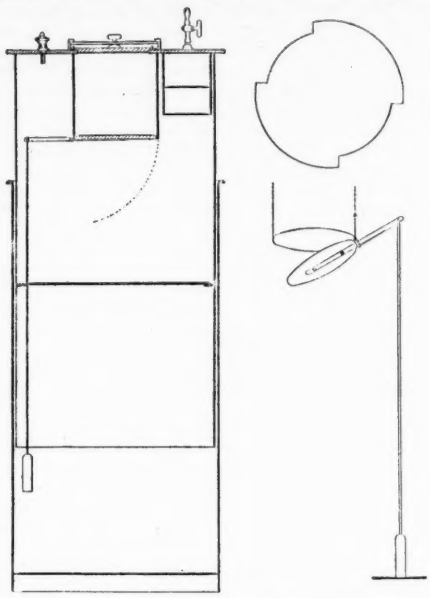
Mr. PRIESTLEY, in reply, explained that the sand used in the top layer of the filtering medium was not all so fine as he mentioned; he found it impossible to get the whole of it anything like so fine. The beds had worked to his satisfaction with the sand as put in. The finer they could get the sand to work properly, the better the filtration. For excavation work under certain circumstances, a steam-navvy would not be so cheap as manual labour; but in this case the contractor who had done the work at 1s. 4d. per cubic yard had offered to do the remainder at 1s. 2d. On the question of punning, the opinion of engineers was about equally divided. Personally, he believed that punning until the moisture was brought to the top was the best way of putting in concrete for work of this class. In his opinion, where a reservoir was being constructed a certain distance from a town —where the Engineer had entire control of the men, and they could not go to his Committee and talk of things behind his back—then work could be done better by administration than contract; but where the work was near a town, then contract work was preferable. Generally speaking, corporations did not pay so much for labour as contractors. The price for masons in Cardiff was 8½d. per hour; labourers, 5½d.; main jointers, 7d. to 8d.; layers, 6d.; navvies, 5½d. The men worked 54 hours in summer, and 51 hours in winter. The £9000 given as the price of the reservoir was a preliminary estimate; but the work would be done for much less. The question of whether a reservoir should be open or covered depended on local conditions. It would not be a difficult matter to cover the new reservoir if desired. The rate of filtration would be explained when he said that the water was upland and not river water. Personally, he considered that all waters, excepting deep-well water, should be filtered before being delivered to the consumers. As to the character of the ground on the sites of the works, it was similar in both places—a clay gravel ground, with boulders, and in some places rock of a shaley nature in it. The question of putting in the asphalte was perhaps more an extra precaution than that he was not satisfied that the concrete itself was sufficient. This was the first time he had used round lead for jointing mains; but he did not care to reduce the sockets too much. He used 4½-inch sockets; but in a long 18-inch trunk main, he was only using 3½-inch ones. So far as tests had been made, he found that this depth was quite sufficient. The reservoir and the tank in the water-tower were simply reserves—the former in case of accident to the main conduit, and the latter for the supply of the immediate neighbourhood. They had had sufficient pumping already, and were doing away with it as far as possible. As to the price of the land, it was really building land, and within 2½ miles of the centre of the town.

REGISTER OF PATENTS.

Generating Acetylene.—Gaskell, G. W., and Reeve, R. F., of Liverpool. No. 14,313; June 12, 1897.

The object of this invention is to enable the generating chamber for acetylene to be re-filled automatically with carbide whenever the gas gets low, without any escape of gas beyond that actually in the charge-box at the time.

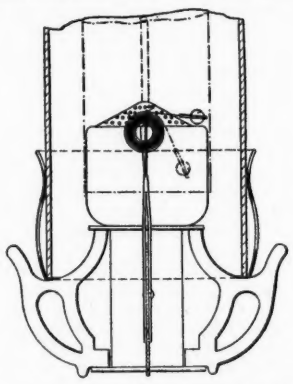
The invention consists essentially in having a charge-box in the gas-holder bell capable of being supplied from the exterior, and so arranged that whenever the bell falls to a given point the box shall discharge its contents into the generator, and as the holder bell rises again shall be automatically closed air-tight. The lid can then be taken off, and the box charged at leisure. The bottom of the supply-box is balanced on a lever, hinged to the side of the box. The other end of the lever has a weight suspended from it by a chain, bar, or the like, in such manner that when the bell approaches its lowest position the bar or weight rests on the bottom and allows the trap-door floor of the charge-box to open



and shoot its materials on to the diaphragm or cage of the generating chamber. The generating chamber is formed by placing a removable horizontal diaphragm in the bell, consisting of a disc having two segments opposite each other cut out, with two segments a little smaller fixed to the side of the bell. The consequence is that in one position the bottom will rest on the two side segments, while in the position at right angles thereto it will be clear of them, and can be emptied into the bottom or lifted up with the material on it. Another improvement consists in placing an exit-box on the holder, with two chambers—one filled with sponge, the other with asbestos or any material suitable for purifying and cooling the gas. By this means, if the gas be mixed with air after leaving the holder, "all chance of explosion through residual heat is avoided."

Automatic Gas-Igniters.—Perl, J., of Berlin. No. 15,804; July 2, 1897.

In this automatic gas-igniter, the ignition is effected by a small ball or disc of finely-divided metal of the platinum group. This, when brought in contact with the gas, begins to glow and causes the ignition of the gas. In consequence, however, of the disc remaining in the flame, the property of the finely-divided platinum to glow when in contact with the gas soon ceases; and it must after a short time be replaced by a fresh disc. To obviate this drawback, a construction has been devised in which



the platinum ball ignites an auxiliary flame, which then in its turn ignites the main flame, whereupon the auxiliary flame is automatically extinguished. In this construction, the platinum ball is removed from the intense heat of the main flame; but the construction is complicated, and easily becomes inoperative.

The device may be regarded, in a sense, as an inversion of the construction referred to in this patent, in that the inventor does not move the flame away from the platinum ball but the platinum ball away

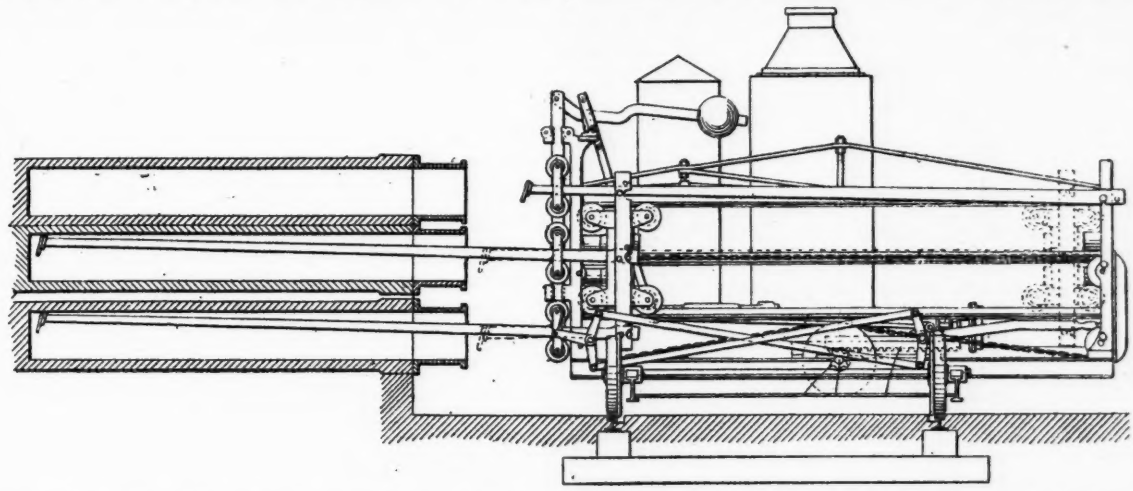
from the flame, or (in the case of an incandescent lamp) from the incandescent body. In the form of construction shown, the platinum ball is secured to the outer end of a helix formed by a metallic strip or band composed of two different metals. The metal having the greater expansion is located at the outer side of the strip or band; while the other or inner end of the helix is fixed to a bar secured by a screw to one of the chimney-carrying arms of the burner. An upwardly-extending rod (also fixed to the bar) forms at its upper end a hook, which takes over the helix, and holds the outer end of the latter, with the platinum ball, in proper working position. The strip or band, when heated, expands; and owing to it forming a helix, and the outer metal being capable of the greater expansion, the helix contracts, so that the platinum ball is carried automatically into the position shown in dotted lines—so far distant from the flame that "its glowing capacity is not in the least impaired."

Discharging Gas-Retorts.—Bronder, G. A., of New York. No. 28,909; Dec. 7, 1897.

The patentee points out that in machines heretofore used for discharging gas-retorts, the rakes are in part supported by a travelling carrier, which runs forward and backward, and in part by a lifting-bar arranged at a fixed distance from the front of the retorts. When this travelling carrier is in its most backward position, only about half the weight of the rake is supported on the lifting-bar; but as the carrier runs forward with the rakes, to project them within the retort, a greater portion of the weight of the rakes is brought upon the lifting-bar. A weighted lever is commonly applied to the lifting-bar, for the purpose of counterbalancing it, and the portion of the weight of the rakes which comes upon it; but as this portion of the weight of the rakes varies in their movement backward and forward, it is desirable that some compensation for it shall be secured. One object of the present invention therefore is to provide means by which this can be effected, by making the fulcrum of the lever adjustable automatically, according to the movement of the carrier and rakes. Another object is to better control the backward and forward movements of the rake-carrier and rakes by a hydraulic governor, so that the movement of the rake-bar is checked toward the end of its travel in either direction.

The illustration represents a side elevation of a retort-discharging machine embodying this invention, and a vertical section of one retort of each of three tiers.

The minor details of the invention may be indicated generally from the claims made on behalf of the patentee. They embrace the combination, in a machine for discharging gas-retorts, of a rake-lifting bar and a counterbalance lever, from which the bar is suspended, and the fulcrum of which is moveable with the rake; mechanism for moving the carrier towards and from the retorts; mechanism for moving the fulcrum, and a connection between the carrier-moving mechanism and fulcrum-moving mechanism, whereby the two mechanisms operate together for shifting the fulcrum with the backward and forward movement of the rake-carrier; the combination of a carriage, two or more rakes, a carrier for the rakes, and means for moving the carrier backward and forward on the carriage; a lifting-bar on the carriage, common to the several rakes; a counterbalance lever from which the lifting-bar is suspended, and the fulcrum of which is moveable; mechanism for moving the fulcrum; means for connecting the rakes with the carrier and carriage, whereby one or more of them may be moved with the carrier while the others are held stationary on the carriage; and a detachable connection between the



fulcrum-moving mechanism and carrier-moving mechanism. Combined with the rake-lifting bar, the main frame or carriage, and the counterbalance lever connected at one end with the bar, is a lever having its fulcrum on the main frame or carriage, and carrying the fulcrum of the counterbalance lever, and swinging links by which the latter lever is connected with its fulcrum. The guide for the bar consists of rollers pivoted in the frame or carriage, in front of, and behind, the bar, to receive the lateral thrust of the bar. The mechanism for moving the rake-carrier consists of a piston connected with the mechanism, and a hydraulic cylinder in which the piston works, and between the ends of which, on opposite sides of the piston, there is a passage with ports at such different distances from the cylinder heads as to be successively closed by the piston in its movement, for the purpose of gradually arresting the movements of the rake-carrier and rakes in either direction.

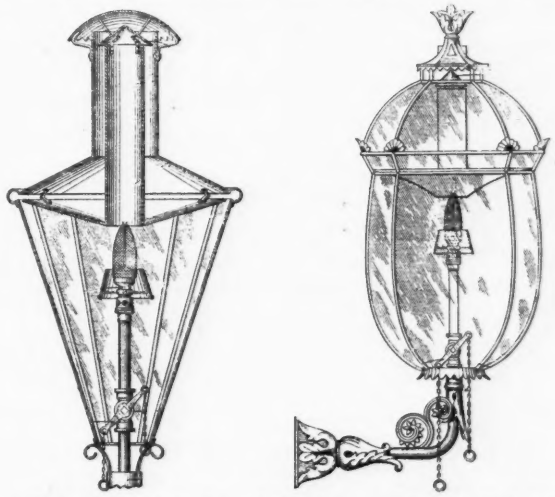
Incandescent Gas Mantles.—Kayser, H., of Berlin. No. 14,259; June 11, 1897.

This is a process for the manufacture of bodies for incandescent lighting, in which, after a skeleton of earthy oxides has been formed in the usual way, by impregnating a fabric with a suitable solution of salts of the oxides, and burning off, the skeleton is impregnated with "binding salts," and exposed to the action of a flame, and subsequently re-dipped into a solution of salts of earthy oxides—the process being repeated as many times as desired.

As an example of the process of manufacturing incandescent bodies according to this invention, the woven or other fabric employed is first saturated with a solution of thorium, and subsequently exposed to a flame, by means of which the fabric is burnt away or entirely destroyed; leaving behind a skeleton which consists entirely of the oxide. This is dipped into a 0·1 per cent. up to a 5 per cent. solution of suitable salts—such, for instance, as a solution of nitrate of potassium—the resultant body being then dried and exposed to a flame to glow. The saturating of the fabric with a solution of thorium, the exposure of the fabric to a flame, and the coating of the skeleton with a solution of suitable salts, may be repeated as many times as desired. Each operation serves to thicken the substance, and add to the strength and stability of the resultant body; while each coating of the salts acts as a "solder, weld, or braze," to combine or unite each coat of oxide with that preceding and following it. Finally, the patentee proposes to saturate the resultant body with a concentrated solution of thorium, which, after exposure to a flame, may then be coated with a thin solution of cerium.

Street-Lamps with Unprotected Incandescent Gas Mantles.—Sheldrake, J. H., of West Norwood. No. 17,819; July 29, 1897.

For the purpose of this invention, the body of the lantern of a street or outside gas-lamp is made in the usual manner, as shown, and fitted with an inverted cone reflector within the upper part. Above the central part of the cone is a tube, rising well up within the upper shell, and surmounted by guard-cones to protect the inner tube from the action of a down-draught. The burner supply-pipe is carried well up into the body of the lantern, and provided with the usual holes for the proper admixture of air and gas within a short length of tubing. This carries the burner proper and the incandescent mantle, the top of which just enters the opening of the central tube. Surrounding the burner is another

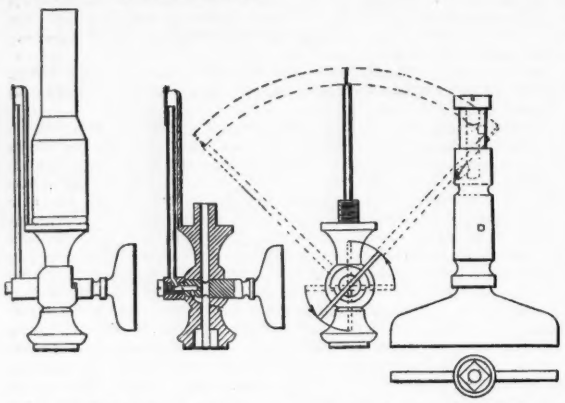


cone, the top of which is of equal diameter, or nearly so, to that of the central upper tube which carries off the products of combustion. The lower cone (of glass or other transparent or opaque material) surrounding the burner is of such depth that it directs the air entering from the lower part of the lantern to the outside of the mantle "for effecting perfect combustion, and for enhancing the brilliancy of the incandescent flame; the mantle being left unprotected."

Automatic Gas-Lighter.—Hoffmann, F., and Ohlsen, W., of Kiel, Germany. No. 23,804; Oct. 15, 1897.

This automatic gas-lighter is provided with an auxiliary pipe adjacent to the main burner, with spark-gaps or contact breaker; and it is constructed with ports or passages leading to the auxiliary pipe through the

main burner plug, and also sliding electrical connections upon the plug, so that at one operation the gas is turned on in the main burner and the auxiliary pipe and electric sparks are formed, igniting the auxiliary jet, which in turn lights the main jet.



When applied to the ordinary rotary gas-plug tap (as shown), there is provided a partial groove upon the plug body, and a port leading into a passage situated in the smaller end of the plug. These are so placed relatively to one another that, when the main gas supply is turned off, the port is not in communication with the channel or groove; but when it is turned on, the port is in communication with it. The main gas supply is of the usual type—through a passage in the tap body and a perforation in the plug. The passage in the tap at its smaller end leads to a short auxiliary pipe attached by a ring integral with it to the portion of the plug projecting beyond the casing or body, and it is evident that when the plug is turned on a small supply of gas will flow into the auxiliary pipe.

One terminal of a battery circuit is fastened to the metal of the casing, and the other to an insulated extension placed upon the tap body in such a position that a point-piece attached to the top of the auxiliary pipe when the tap is opened comes immediately underneath the termination of the insulated extension, thus forming a spark-gap. The auxiliary pipe is placed immediately underneath the main jet-pipe which it is desired to light. When the gas-cock is turned off, the electrical circuit is broken, and no gas passes either into the main jet-pipe or into the auxiliary jet-pipe; but when the cock is turned on, a small bye-pass flow takes place into the auxiliary pipe, simultaneously with the flow of the gas into the main jet or burner. At the same time, the end-piece of the auxiliary pipe comes underneath the termination of the extension, and allows high-tension sparks to pass across the mouth of the auxiliary tube. The ignition of the jet then takes place, followed at once by that of the main jet.

Automatic Gas-Lighting Device.—Borchardt, H., of Berlin. No. 3086; Feb. 7, 1898.

This is a modification of patent No. 2288 of 1897—in which an expansible body heated by the burner and communicating its motion to an intermediate mechanism, automatically opens the gas-valve—and it consists of an insulating tubular carrier within which the expansible body is enclosed, for the purpose of protecting it from the injurious effect of direct contact with the flame.

APPLICATIONS FOR LETTERS PATENT.

11,561.—Sugden, D., "Connecting incandescent gas lighting with the anti-vibration system." May 23.

11,565.—Ely, H., "Acetylene gas generators." May 23.

11,573.—Glover, R. T. & J. G., "Increasing the initial velocity of bunsen flames." May 23.

11,576.—Tweedie, R. O., "Preventing the breaking of incandescent gas mantles." May 23.

11,578.—Govan, A. A., "Gas-heater." May 23.

11,676.—Evans, E., "Washing and purifying gas." May 23.

11,683.—Cowell, T. T., "Incandescence burners." May 23.

11,714 5 6 7.—Rogers, F. M., "Acetylene lamps." A communication from Sir C. S. Forbes. May 24.

11,738.—Lanchester, F. W., "Gas and oil motor engines." May 24.

11,781.—Francetti-Schieroni, E., "Manufacture of acetylene gas." May 24.

11,848.—Southall, J., "Gas or oil engines." May 25.

11,871.—Michel, J. R. & E., "Gas-regulators." May 25.

11,874.—Golby, F. W., "Producing acetylene." A communication from E. Caplat. May 25.

11,910.—Bartlett, J., "Acetylene gas generator." May 25.

11,964.—Bollé, C., "Generating acetylene." A communication from P. Dreske. May 26.

11,970.—British Pure Acetylene Gas Syndicate, Ltd., and Keene, T., "Acetylene gas generators." May 26.

11,990.—Thinault, A. E., and Dreyfus, M., "Generating and burning acetylene." May 26.

12,011.—Deimel, F., Lehmann, J., and Sylten, A., "Electric gas-igniters." May 26.

12,012.—Falk, S., "Lamp for acetylene gas." May 26.

12,021.—Pipersberg, H., "Tell-tale for coin-freed gas-measuring indicator mechanism." May 26.

12,022.—Rigby, J. K., "Generation of acetylene." May 26.

12,061.—Sarth, J. E., and Ferro, W. K., "Generating and burning acetylene gas." May 27.

12,173.—Williams, R., "Acetylene generators." May 28.

12,182.—Justice, P. M., "Manufacture of acetylene gas." A communication from V. Sardi. May 28.

12,198.—Mottlau, A. J., "Continuous production of acetylene gas." May 28.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Workmen's Compensation Insurance.

Sir,—With reference to the above subject, doubtless most gas managers have received offers at considerably lower rates than 25s. per cent., which is quoted by the associated offices. I would recommend them, before effecting an insurance, to look very carefully into the terms of the policy. I am informed that some of the offices quoting lower rates, so word the policy that the Insuring Company is completely at the mercy of the Insurance Office. A claim for permanent disablement will only be paid (after it has accrued) so long as the policy is continued; and there seems to be nothing to prevent the Insurance Offices increasing the premium when, and to what extent, they feel inclined. If the insurer protests, he will be told he has the alternative of allowing the policy to lapse, and the Insurance Office will have no further liability in the matter. How far this position would be upheld in a Court of Law I cannot say; but I imagine no one wants to have the trouble and annoyance of testing the question.

What we all require is absolute insurance against any and every liability. Certainly 25s. per cent. seems a heavy premium; but as you have already pointed out, one-tenth of a penny per 1000 cubic feet, or 1d. per ton of coals, will cover it. In any case, there is no compulsion for the Insurance Office to take the business at all; and considering the very uncertain character of it, one cannot well blame them for protecting themselves, when there are absolutely no data to guide them in fixing a rate.

I believe in Germany, before the passing of the Act, accidents were under 1 per cent. of the total number of workmen employed; and they have now risen to over 9 per cent. Mr. Livesey's experience in the case of the South Metropolitan Gas Company's workmen is not reassuring.

Of course, every one wishes to save 1d. per ton of coals if he can; but in any case insurance is going to cost something. Some of the larger companies may find it advantageous to take the risk themselves; but for small concerns 1d. per ton is not a matter of vital importance, if in return they get absolute freedom from further liability.

Ely, June 1, 1898. Thomas A. Guyatt.

As bearing upon an important point brought forward by our correspondent, we give the following paragraph, which appeared in one of the London daily papers last Friday: "A meeting of the Midland Unmarked Bar Association was held at Birmingham yesterday, to consider the question of insurance under the Workmen's Compensation Act. A discussion took place as to whether the Staffordshire iron trade should combine and offer their insurances *en bloc* to any Insurance Society seeking such business. The Executive Committee were instructed to ask various companies to forward copies of their draft policies, and to state whether the rate of premium would cover the permanent liability to injury of any of the operatives, providing, after the first twelve months, the employer should change his office."

It may be of interest, in this connection, to reproduce a letter which Mr. J. H. Penney, the Hon. Secretary of the North of England Gas Managers' Association, has addressed to the members, as the result of what took place at the last meeting. It is as follows:—

Dear Sir,—The Committee of this Association have had under consideration the question of insurance under the Workmen's Compensation Act, 1897, the Employer's Liability Act, 1880, and at common law. It was thought probable that in case Insurance Companies were willing to quote a sliding-scale, varying with the total amount issued, the majority of Gas Companies and Local Authorities owning gas-works in the North of England would be willing to join therein; hence the Committee have been in communication with several first-class Insurance Offices, and have succeeded in securing the following special quotation:—

On wages not exceeding	£100,000 . . .	10s. 6d.	per cent.
" " " "	150,000 . . .	10 0	"
" " " "	200,000 . . .	9 6	"
On wages exceeding	200,000 . . .	9 0	"

Therefore it will be seen that the larger the number of Gas Companies and Local Authorities insuring under this scheme the lower the premium will be to each.

If you are willing to join this combination, and thus participate in the reduced rates in question, I shall be glad to hear from you, with a statement, for the guidance of the Committee in the meantime, showing the total amount of wages you have paid during the past year and the average number of men you employ, also the total amount of salaries you paid during that period, and the number of officials you employ, if you are desirous of including them in your insurance.

The rate for individual Gas Companies and Local Authorities, not wishing to join the combined scheme, would be 12s. per cent. on the amount of wages paid.

I may add that there has been an alternative "profit-sharing" scheme submitted by a good office. The terms are briefly as follows: A premium of 15s. per cent. on the amount of wages paid annually. From the total premium, 20 per cent. would be deducted to cover all administration expenses. For example: If your premium amounts to £250, there would be deducted by the Insurance Company, to meet all expenses, 20 per cent.—*i.e.*, £50—the balance (£200) being placed in a separate fund; and if the claims were £130, of the balance remaining you would receive, on renewal of the policy, half—*i.e.*, £35.

You will be in no way liable for any part of a loss under the insurance, as if the losses amounted to even £10,000 they would be wholly borne by the Insurance Company; this being purely a "profit-sharing" scheme. The loss on one year, however, would be placed against any profit of the next year, but not against the third year; in other words, the loss is not cumulative. You could never be called upon to pay more than your annual premium, however great the losses under your policy. The whole expenses deducted from the premium would be limited to 20 per cent. of such premium; any excess being borne by the Insurance Company.

As the Workmen's Compensation Act, 1897, comes into operation on the 1st of July, and there is not much time to lose, the favour of your

reply, not later than the 7th of June, will oblige, stating which scheme you would prefer to insure under—the joint sliding-scale, individually, or the "profit-sharing."

Simmance's Governor.

SIR,—I have too great a respect for Mr. D. Bruce Peebles to reply to his letter in its own tone, but cannot refrain from pointing out that his governor patent he himself considers not good enough to maintain. This is, no doubt, because he has discovered that Flürscheim protected the same construction—disc, permanent leak, and all—some years before Mr. Peebles's patent.

It was with all the records of success and failure with governor patents before me, that I applied for my own; and I believe that it touches the bed-rock of simplicity, cheapness, and accuracy.

Page Street, S.W., May 28, 1898. JNO. F. SIMMANCE.

The Price of Gas in London.

SIR,—The exorbitant price charged by The Gaslight and Coke Company, as compared with the South Metropolitan Company, is fortunately attracting the attention it deserves. Large public meetings are being held, clamouring for an "inquiry;" and, what is much more ominous, every section of the Press, representing all shades of opinion and classes, has fiercely denounced the "mismanagement" as focussed and directed from Horseferry Road. It therefore appears that there was ample justification for the "impeachment" of Mr. George Livesey at the last half-yearly meeting.

The gas supply of London is next in importance to that of water; and it is simply amazing to see what small interest is taken in it by those who are most concerned—viz., the 4 millions of inhabitants. Occasionally there is a little individual grumbling at the amount of the gas bill, which is generally explained away by the suave gentleman who calls for the money; and the matter and the meter go on as before. This supineness on the part of the public arises from various causes; the principal one being ignorance. Most people imagine that, somehow, gas is "controlled by Government;" and this absurd idea has been encouraged by a speech of Colonel Makins, when he stated that his Company was a *quasi* Government Department. Of course, this dust-throwing had (as was intended) its effect on the unthinking consumers. A storm, however, has now arisen; and it is earnestly to be hoped that it will not subside till one price is charged for gas all over London—this price to be the lowest charged by any one Company. At present this is the South Metropolitan Company—always the pioneer of cheap gas.

It is passing strange that this agitation did not arise directly from the public, but from a speech made by Mr. George Livesey—the "High Priest" of the gas interests, and the Chairman of two of the largest London Gas Companies, and, what is more extraordinary, a shareholder in the "impeached" Company. Here is a combination of circumstances difficult to understand; and it can only be presumed that, having repeatedly pointed out to them the suicidal policy they were pursuing, without any change being made, his soul was vexed at the "unholy" proceedings, and he resolved, if possible, to save them, in spite of their folly.

This speech would never have been made but for the announcement of Colonel Makins that the price of gas was to be raised from 2s. 10d. to 3s. per 1000 cubic feet to ordinary consumers, which works out at something like 3s. 9d. to the poor, who buy their gas by pennyworths through prepayment meters. This was the last straw; and the bolt fell. I would remark here that The Gaslight and Coke Company supply a portion of the southern district at 2s. 3d. per 1000 cubic feet, charging in the North and West 3s. for gas of the same quality. Can absurdity go further than this? Even the "Daily Telegraph" pointedly referred to the anomaly in a specially strong paragraph a few days ago.

At the half-yearly meeting referred to, Colonel Makins contended that this increase in price was necessary to enable him to pay the shareholders the statutory dividend of 12¼ per cent.; not a word being said as to the unfortunate consumers. For many years a dividend of 12¾ per cent. has been paid, not out of profits fairly earned from year to year, but taken from the reserve fund, which was only intended for contingencies. This fund has now been depleted to the tune of £750,000, all to pay unearned dividends. This pleasant and easy arrangement would have gone on for ever, but for two reasons: First, that the fund had become exhausted; and, secondly, that Nemesis was at their heels in the person of Mr. George Livesey.

The gas supply of London is in the hands of three men; and, to give them all the honour they deserve, it is necessary to name them. They are Colonel Makins, Mr. George Livesey, and Mr. H. E. Jones. These three between them control capital to the extent of more than £50,000,000. It is also an unprecedented monopoly, and carries vast responsibilities, as none other than the Companies can sell a single cubic foot of gas in London. True it is they work under an Act of Parliament; but this has been so carelessly drafted that it gives them almost unlimited powers as to price, &c. Though these powers are somewhat modified by the action of the sliding-scale, which makes the rate of dividend dependent on the price of gas, in consequence of the piling up of the reserve funds, which can at any time be used for purposes of dividend, as shown above in the case of The Gaslight and Coke Company, its benefits to the public are more apparent than real, the author of this sliding-scale was Mr. George Livesey; and in the case of his Company it has worked with great advantage to the consumers.

Further, the Act of Parliament is widely open to misconstruction in other important respects. There is now conflict between the London County Council and the Gas Companies as to the interpretation of certain clauses on the matter of testing, presumably inserted for the protection of the public, who are at present without any remedy, and will continue to be so till the Act is amended. These doubtful clauses have been, in the opinion of the late Chemist to the Council, systematically taken advantage of in sending out the bulk of the gas of an illuminating power of from 13 to 15, instead of 16 candles. But this grave charge of the Chemist to the Council is at present unsupported.

The Morleyan "plain man" would imagine that, as all the London Gas Companies make their gas under the same conditions, uniformity of price would prevail. But what are the startling facts? The Gaslight and Coke Company charge 3s., the Commercial Gas Company 2s. 6d., and the South Metropolitan Company 2s. 3d. per 1000 cubic feet. Various reasons have been assigned for these inequalities in price. Colonel Makins, in a 46-page pamphlet issued to his shareholders, attributes it, among other things, to the electric light, and to the fact that some of the streets are paved with wood and asphalte, and that there are a less number of testing-stations in the southern district—thus suggesting that this inadequate testing enables the South Metropolitan Company to send out gas of lower illuminating power, and thus save expense. This charge of inadequate testing was effectually disposed of in a letter by Mr. Livesey to the "JOURNAL" for the 3rd ult.

Mr. Livesey has had an easy task in brushing aside all these flimsy notions of Colonel Makins. The public have now the opinion of the greatest living authority on gas matters; and it rests with them whether they will go on paying in the North 3s. for what is obtained in the South for 2s. 3d. A remedy for these anomalies in the price of an article so generally used as gas will have to be found; and one would be the lowering of the illuminating power from 16 to 14 candles. This would save all the cost of enrichment. Such gas could, and would, be supplied by the South Metropolitan Company at 2s. per 1000 cubic feet; and the other two Companies should be compelled to sell it at the same price. If they are unable to pay current dividends, let them take advice from their neighbour over the water, and they will soon be able to do so. In the present day of incandescent and other improved burners, it is a national waste to make gas of a higher illuminating power than 14 candles. It would be good enough for lighting, and equally useful heating for and cooking purposes. This was fully proved some years ago, when the South Metropolitan Company sent out for a fortnight unenriched gas (by permission of the London County Council), and no complaints reached the office; thus proving that the consumers were satisfied.

June 1, 1898. J. VINCENT TAYLOR.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS COMMITTEE.

(*Before Lord* HAWKESBURY, *Chairman, the Earl of* CRAVEN, *Lord* RIBBLESDALE, *Lord* METHUEN, *and Lord* MONK BRETTON.)

The above-named Committee commenced, on the 17th ult., the consideration of the

ROCHDALE CORPORATION WATER BILL,

under which the Corporation of Rochdale sought power to purchase the undertaking of the Todmorden Water Company, and to carry out new works, including three storage and two covered service reservoirs, and various conduits or lines of pipes, catchwaters, &c., necessary in connection therewith; also to sell water in bulk to local authorities or bodies.

Counsel representing the promoters were Mr. Pope, Q.C., Mr. Claude Baggallay, Q.C., and Mr. R. W. Harper. There were a considerable number of petitions against the Bill. Those appeared on were: The Company and Proprietors of the Rochdale Canal, represented by Mr. Hans Hamilton; Mr. Isaac Hartley, by Mr. Lewis Coward; the Todmorden Water-Works Company (against alterations), by Mr. Worsley Taylor, Q.C., and Mr. Bairstoll; the Lancashire County Council, by Mr. Worsley Taylor, Q.C., and Mr. Gerald Fitzgerald; the West Riding of Yorkshire Rivers Board, by Mr. Pembroke Stephens, Q.C., Mr. Reader Harris, Q.C., and Mr. W. H. Williams; the West Riding of Yorkshire County Council, by Mr. Pembroke Stephens, Q.C., Mr. Reader Harris, Q.C., and Mr. W. H. Williams; the Littleborough Urban District Council, by Mr. Balfour Browne, Q.C., and Mr. Ram; Messrs. R. H. Scott, Limited, by Mr. Moon; the Corporation of Dewsbury, by Mr. Honoratus Lloyd; the Todmorden Corporation, by Mr. Balfour Browne, Q.C., and Mr. Duke; and Messrs. Alexander Molesworth and others, by Mr. Wedderburn, Q.C. Appearances were also entered on behalf of a number of other bodies and persons.

From the opening statement of Mr. Baggallay, it appeared that the purchase was not compulsory; an agreement having been arrived at. Rochdale had a population in 1891 of some 71,000 persons; a net rateable value of £300,000; and an area of 4185 acres. Since 1866, the Corporation had been the Water Authority for the borough; and their power of supply extended to several urban districts adjacent. The storage works of the Corporation at present consisted of the Brownhouse Wham reservoir, of 47 million gallons; the Hamer Pasture reservoir, of 72½ million gallons; the Buckley Wood reservoir, of 24¼ million gallons; the Cowm reservoir of 228 million gallons; and the Spring Mill reservoir, of 133 million gallons—a total storage capacity of 505 million gallons, which was equal to a daily supply of 2 million gallons. In 1897, the consumption had reached 1,952,000 gallons per day. The result was that, if they were to have anything like a season of drought, such as that of 1887 or 1893, it would be impossible to keep up the constant supply. There could be no doubt that Rochdale required more water at once—indeed, so pressing was the need that the Corporation approached the Todmorden Water Company, and came to an agreement under which they would, if the Committee sanctioned it, obtain at once the use of the surplus water of that Company. The Company had a supply of about 450,000 gallons a day, the demand upon which was only 100,000 gallons a day; so that there was some 350,000 gallons daily which would become immediately available, and would enable the Rochdale Corporation to meet their needs while further works were being constructed. The Todmorden Company were incorporated by statute in 1882; the principal portion of their area being within the borough of Todmorden, which was also largely within the district of supply of the Rochdale Corporation. The Todmorden Company secured their powers because the Todmorden Local Board had done nothing for years to provide Todmorden with water, though the necessity of taking this step had been pressed on them over and over again. The Local Board, in order to induce Parliament to reject the Bill (the one of 1882), passed a resolution which was put in evidence—"That the members who give evidence before the Committee of the House of Commons, be empowered to pledge this Board to carry out an efficient

water scheme during the next session of Parliament." This pledge, however, had not been carried out. The Board were then given another opportunity; for it was provided that, if within twelve months of the construction of the works, the Board wished to purchase, they should be allowed to do so. But this also was not acted upon. Throughout, Counsel asserted, the Local Board had treated the Company in a most unfriendly manner. They had declined to put in force their powers under the Public Health Act, of compelling persons not properly supplied to take water—with the object, Counsel further asserted, of crippling the Company, and subsequently purchasing the concern cheaply. Negotiations for purchase were opened by the Todmorden Corporation with the Company in October, 1896, and by the Rochdale Corporation in August, 1897; the Company offering their works at substantially the same price to both Corporations. The Todmorden Corporation did not avail themselves of their opportunity, with the result that on Oct. 22 last the agreement for purchase was made with the Rochdale Corporation. The Todmorden Corporation then deposited two Bills—one for the compulsory purchase of the concern, and the other empowering them to go to Gorpley Clough and construct a further reservoir there, with which to get a fresh supply; the intention being to block the Rochdale Corporation, who had proposed by the present Bill to go to the same place with the same object. The first Bill had been withdrawn; the second only being left. This it was intended to use solely as a block to the Rochdale Corporation, for the Todmorden Corporation had formally stated their intention not to proceed with the Bill if the present Committee should refuse to sanction the transfer of the Todmorden Company to the Rochdale Corporation. The effect of this would be that the Rochdale Corporation would be unable to use the surplus water of the Company, and would also be deprived of the largest of the drainage areas and of the storage reservoirs it was proposed to utilize. With regard to the petition of the West Riding County Council, he said the gist of it was an allegation of undue abstraction of water. Not only, however, was the quantity of water taken not undue, but, by the uniform discharge of compensation water, a continuous supply would be kept up in the dry season, when no doubt, but for that water, the pollution might become offensively bad. They also complained that the water was such that, if put into lead pipes or fittings, it would be apt to take up lead. This, however, was purely a matter to be dealt with on clauses. Counsel did not deal with the petition of the West Riding Rivers Board, because he should object to their *locus* if they attempted to intervene.

Mr. James Mansergh, the first witness for the promoters, was examined on Wednesday, May 18. He said the present sources of the Rochdale Corporation yielded about 2 million gallons a day; and the consumption in 1897 being about 1,952,000 gallons daily, it was imperative that immediate provision should be made for augmenting the supply. Looking forward, he estimated that the consumption in 1916 would be 3,142,000 gallons. To provide for the supply of the town till the projected works could be executed, it would be proper to use the surplus water of the Todmorden Company. This Company were selling only 100,000 gallons daily of their supply of 460,000 gallons, so that there was a surplus of 360,000 gallons a day. An agreement for purchase had, therefore, been provisionally entered into between the Rochdale Corporation and the Company. It was not a usual thing for a Corporation to ask power to purchase water-works which were supplying another Corporation's area; but in the circumstances, the proposal was justifiable. The Todmorden Corporation had never been in cordial relations with the Company. They objected strongly to the establishment of the Company at the outset. They had the chance of promoting a Bill before the Company's Bill came into effect, and, further, to purchase the undertaking within twelve months of the completion of the works, neither of which had they done. They had distinctly obstructed the Company ever since its formation. Another reason for acquiring the undertaking was that the Corporation were seeking to construct a reservoir below the Company's existing reservoir in the Ramsden Valley, with which to utilize the remainder of the unused drainage area of that Valley; and to do this, it was necessary that both reservoirs should be under one control. This second reservoir would hold 71 million gallons. Besides the water already mentioned, that from another area of 444 acres, around the White Slack Clough, and from other small areas, would drain into this reservoir by means of a catchwater. Compensation water at the rate of 9 inches per annum per acre, would be allowed in respect of all land drained. Another reservoir would be constructed at Gorpley, the drainage area of which was 671 acres. To get at the collectable rainfall, he took the mean annual rainfall of a long term, which in this case was 52 inches. Deducting one-fifth to get the average of three consecutive dry years, and 14·6 inches for evaporation, left 27 inches as collectable. This would give a daily yield of 1,132,312 gallons; or deducting one-third for compensation water, 750,000 gallons. The capacity of the reservoir at Gorpley would be 191 million gallons. This water would be conveyed to a covered service reservoir at Wardle of 2 million gallons capacity. At Hey Head, near Littleborough, it was proposed to construct a reservoir into which water would be gathered directly from 37 acres, and by means of a catchwater from 198 acres. This reservoir would contain 36 million gallons; and the daily quantity obtained would be 158,000 gallons—128,000 gallons being allowed as compensation. From this reservoir, the town of Littleborough would be supplied. With reference to the petitions of the West Riding County Council and the Corporation of Dewsbury, whose borough was 30 miles away, witness said all the watersheds were in Lancashire, and the rainfall was in Lancashire; so that it could not be said that the water was Yorkshire water at all. Moreover, the streams would have the advantage in dry weather of the compensation water.

Mr. Reader Harris was proceeding to cross-examine witness on behalf of the West Riding County Council, when Mr. Pope took exception to his *locus standi* as a Water Authority, though admitting that he might appear in respect of some minor points—such as the effect of the water on lead pipes. Mr. Harris objected to Mr. Pope raising the question after Mr. Baggallay, in opening, had commented on the petition of his clients. Eventually the Committee decided against the latter point raised by Mr. Harris; and after further discussion, they ruled against the right of the West Riding County Council to be heard at all, except on the minor points to which Mr. Pope had referred. Mr. Harris consulted with his clients for a moment, and then informed the Committee that he could not accept any limited *locus*, and was instructed to withdraw from the case, reserving his right, however, to proceed elsewhere. He made an application for costs to be allowed him; but the matter was not pressed.

Mr. J. E. Craven, the Solicitor, and Mr. J. S. Littlewood, the Chairman of the Todmorden Water-Works Company, gave evidence as to the negotiations which passed between the two Corporations and the Company relative to purchase. On June 3, 1897, the Todmorden Corporation and the Company had an interview, at the end of which it was understood that the Corporation would communicate again with the Company; but in the meantime both parties were to regard themselves as entirely free and unprejudiced by what then passed. A considerable time elapsed without the Company hearing from the Corporation. The Company then negotiated with Rochdale, and in the end entered into the agreement for the sale of the concern. It was denied that there was any undue haste, or that the Todmorden Corporation had not full opportunity of effecting the purchase if they chose. In cross-examination, Mr. Craven admitted that he did not know of a single case where a Corporation had been allowed to buy up a Company, supplying in another Corporation's area, against the will of the latter Corporation.

Mr. W. Tomlinson, Resident Water Engineer to Rochdale, gave evidence as to the growth of the consumption of water. He said the rental for domestic supply had risen from £18,998 in 1884, to £26,016 in 1898; the figures for trade supply being £2799 and £6161 respectively.

While witness was under examination, Mr. Pembroke Stephens intervened, and informed the Committee that the petition on which he appeared—that of the West Riding Rivers Board—had been framed on the understanding that a large representation of towns and interests in the district was coming before the Committee from another source. He was told that this representation of Yorkshire interests and Yorkshire feeling had been excluded. He regretted this, because his petition, though framed to support and further the general opposition raised in the petition he referred to, was not in such terms as would enable him to raise the general opposition which was no longer before the Committee. He was surprised that in a case dealing with the head waters of a Yorkshire river—waters which arose in Yorkshire and flowed into rivers in Yorkshire—the *locus standi* of the Yorkshire Rivers Board should be challenged for a moment; but he would not fight the point, as, having regard to all the circumstances, he thought the most convenient course would be to withdraw, reserving the right of the Board to be heard elsewhere.

On the following day, further evidence on behalf of the promoters was given by Mr. H. Rofe, the predecessor of Mr. Tomlinson in the management of the Rochdale Water-Works, Mr. Charles Hawksley, Mr. G. H. Hill, and Mr. J. Redcliff, the Engineer and Manager to the Todmorden Company. The latter witness stated that the whole capital expenditure of the Company up to the present was £61,000. The gross income last year was £1713; but he should now put it at £1896. The capital consisted of £40,000 in ordinary shares, and £5620 of 5 per cent., and £4380 of 6 per cent. preference shares, all of which had been issued. There was also £11,000 of borrowed capital bearing 3 per cent. interest; and they had power to borrow another £1500. In 1896, half the dividends were paid on the preference shares, but nothing on the ordinary. Todmorden was situated in three narrow gorges; and a large part of the district was moorland. The water obtained was of excellent quality. He also spoke as to the bad terms on which the Corporation and the Company had existed.

Mr. Littlewood, recalled, stated that the concern was offered to both Corporations at the same figure; but after the negotiations with the Todmorden Corporation fell through, there was a slight abatement in the figure. The price agreed with Rochdale was practically £114,000.

Various petitions were then dealt with; the first taken being that of the Littleborough Urban District Council, on whose behalf there were called Mr. James Rhodes and Mr. S. Brooks, members of the Littleborough Urban District Council, Mr. C. E. Newton, Mr. F. H. Shuttleworth, formerly Surveyor to the Local Authority of Littleborough, and Mr. George Wild, the present Surveyor. From their evidence, it appeared that the general feeling locally was that they should supply themselves with water. In some earlier legislation, it was provided that Littleborough was not to be charged by the Rochdale Corporation for water more than 10 per cent. on the net value; the maximum charge for the other districts being fixed at 12½ per cent. It was felt to be a grievance that, though the other districts were actually charged only 10 per cent., Littleborough was charged their maximum, which happened to be the same figure. They held that the Hey Head reservoir part of the scheme should be eliminated from the Bill, in order that they might undertake it—a course which they believed would result in their supply being obtained more cheaply. Mr. Newton claimed to have a special knowledge of the district. The works with regard to the Hey Head reservoir—sufficient for the supply of Littleborough—could be carried out for about £20,000, to repay which, with capital and interest, would require £1200 a year, against the £1947 which Littleborough was now paying Rochdale. Witness was closely cross-examined by Mr. Pope; but he adhered to his figure of £20,000, though it was put to him that the estimate of Mr. Mansergh, for approximately the same works, was £69,000.

The petition of Dewsbury was next taken, in support of which evidence was submitted: By Mr. Mark Oldroyd, M.P., formerly Mayor of Dewsbury, and Chairman of the Directors of Messrs. Oldroyd and Sons, Limited, of Dewsbury, who employed some 2600 hands; by Mr. Frederick Ellis, President of the Dewsbury Chamber of Commerce; and by Mr. J. Haley, Mayor of Dewsbury. Their objections related to the proposals to take water which they contended fed the Calder (on which Dewsbury is situated), at some distance up the stream, out of the watershed. This would certainly be injurious to the industrial interests on the stream lower down, especially in summer time, when the river got very low and proportionately foul. Further, as the water would be removed from the watershed, the effluent would not return to the Calder—a method which, if repeated, might be disastrous to the other concerns on the river banks. The river would also be deprived of the freshets which had the effect of scouring out the impurities accumulating during the normal flow of the river. In view of these facts, the Committee were asked not to allow Rochdale to interfere with water in the watershed of the Calder.

On Friday, May 20, the case of Messrs. Alexander Molesworth and others, millowners on streams the watersheds of which would be drained into the Hey Head reservoir, was gone into. The witnesses called were Mr. W. H. Dixon, Manager of the Gale Mills, and Mr. J. T. Wood, Engineer, of Rochdale and Manchester. Messrs. Molesworth were the owners of the Gale Mills and the Town House Mills, calico works, at which they used in all about 471,000 gallons of water a day, which, with the aid of

reservoirs, they had always been able to procure from streams and springs. In return for impounding the river of the watershed, compensation to the extent of 128,000 gallons daily was proposed; but even supposing the Gale and Town House Mills obtained this quantity, it would be useless, because the mills could not be worked in sections—they must be kept fully operating or not work at all. There was no third course between the Committee refusing to sanction the Hey Head reservoir part of the scheme, and abolishing the mills by buying them up. Further, it was not at all certain that the 128,000 gallons would reach the mills, as there were mills higher up the stream which would have power to use the water. Mr. Wood differed from Mr. Mansergh as to the available rainfall of the district. He accepted the initial figure of 52 inches; but instead of allowing one-fifth to arrive at the mean of three consecutive dry years, he allowed one-sixth—a step which was based on actual experience of the district. Then Mr. Mansergh put the loss by evaporation, &c., at 14 inches; but witness had never heard of more than 12 inches being allowed in these mountainous districts, where the valleys were very steep. In this way, he calculated the rainfall at 32 inches, against Mr. Mansergh's 27 inches; and even then something more should be allowed for the whole watershed being very spongy and boggy, the effect of which was that nearly all the water was stored until the fine weather, when it would be let off by its own pressure in a perennial flow. It had been suggested, in cross-examining Mr. Dixon, that the mills could not use 471,000 gallons of water daily, seeing that the watershed would not yield it. Witness, however, went through a calculation, based on Mr. Mansergh's figures of 27 inches on 235 acres, but taking 311 (not 365) as the number of working days in the year—these being the only days on which compensation water would be allowed—as a result of which he showed that the available rainfall was 461,000 gallons a day. He further pointed out that some of the supply to the mills came from springs, which quite possibly got their water from another district altogether.

Mr. Wedderburn, in summing up the case for the millowners, asked the Committee to throw out the portion of the Bill relating to the Hey Head reservoir.

TODMORDEN CORPORATION WATER BILL.

Evidence in support of the proposals of the Borough of Todmorden was then taken from Mr. C. Hoyle, the Mayor of the town, who detailed at length the steps that had been taken in the past with regard to the water supply of the borough, and the negotiations which passed with reference to purchase between the Corporation and the Company, and subsequently between these bodies and the Rochdale Corporation. On June 3, 1897, the Todmorden Corporation had an interview with the Company, at which the price of £128,000 was asked by the Chairman of the Company. The parties separated on the understanding that the Corporation would submit an offer later on; the Chairman of the Company remarking, however, that both sides were to regard themselves as unbound. The next thing Mr. Hoyle heard was on Aug. 31, when, casually, he learnt that the Company were negotiating with Rochdale. On Sept. 7, he called on the Company with an offer, but was then informed that they had given an option at the same price to Rochdale for six weeks. The Todmorden Corporation thereupon lodged a Bill for the purchase of the undertaking, and another for obtaining a further supply from Gorpley—not being then aware that Rochdale was applying for power to go to the same area. Ultimately the former Bill was abandoned. With regard to the small quantity of the Company's water used by the town, he said this was accounted for by the fact that they were largely supplied by landowners who had private works in the hills surrounding the town. There was a strong local feeling in opposition to the proposal of the Rochdale Corporation to purchase the Company.

Upon the conclusion of Mr. Hoyle's statement, and before proceeding to cross-examination, Mr. Baggallay made a suggestion with a view to shortening the case, to the following effect: That the Rochdale Corporation should have power to purchase the Todmorden Water-Works Company's undertaking; that the Todmorden Corporation should have power to construct works in the Gorpley watershed, as they proposed; that the Todmorden Corporation should come under an obligation to commence their Gorpley works (say) within a period of three years from now, and complete them in seven years; that if Todmorden did not commence and proceed with their works in Gorpley, then they should not oppose the Rochdale Corporation if, at the expiration of seven years, they found it necessary to come to the Gorpley watershed; in the meantime the Rochdale Corporation to supply Todmorden as the Company were doing now—that is to say, for the whole seven years the Rochdale Corporation to be under obligation to supply the borough of Todmorden as the Company did now, until Todmorden had had seven years in which to avail themselves of the Gorpley scheme; then if the Todmorden Corporation did not proceed with the works at Gorpley, and so put themselves in a position to supply themselves at the end of seven years, the Rochdale Corporation should continue to supply Todmorden as if Todmorden remained part of the district as at present; and, further, if at the end of seven years the Todmorden Corporation had proceeded with their works in the Gorpley Valley, and obtained water to supply themselves, the Rochdale Corporation would sell to Todmorden the mains and pipes for distribution which were within the borough of Todmorden, at a price to be fixed by agreement or arbitration. It came to this—that Rochdale would carry on the present supply in Todmorden, and get the surplus from the Todmorden Water Company for Rochdale generally; at the end of seven years, if Rochdale *bonâ fide* proceeded with the works in the Gorpley Valley, they would have those works; and, further, the mains and pipes within Todmorden would be transferred to them at the end of seven years.

After an adjournment to enable Counsel to confer with their clients, Mr. Balfour Browne said that, though if they had gone on the Todmorden Corporation would have wished for some better terms, he thought the proposal a fair one, and that it would be wrong for the Todmorden Corporation to carry the matter further.

Mr. G. F. Deacon was thereupon called and gave formal proof regarding the Gorpley scheme of the Todmorden Corporation, which relates to a drainage area of about 690 acres, with a yield of about 1000 gallons an acre, including compensation. The reservoirs were designed so that one might be carried out in the first instance, and others added as the consumption increased. Their cost would be £109,000; and having looked at all the other available places in the neighbourhood, he was convinced that they were the most economical and best that could be constructed for the supply of the town. The water was excellent in quality, and sufficient in quantity.

Mr. Gerald Fitzgerald, with reference to the petition of the Lancashire County Council, said it related to the necessity for the filtration of the water and the advisability of the county officers being allowed to inspect and examine the process of filtration, and to take samples from time to time. The County Council were now informed that the Local Government Board were considering a general clause relating to the inspection of filtering processes. In these circumstances, the County Council would withdraw their petition; awaiting the preparation of the Government clause, and reserving all their rights, if necessary, in the other House.

Eventually, the Committee decided that both Bills might proceed. The Chairman added that the Committee felt very keenly the strength of the case of the firm represented by Mr. Wedderburn. They trusted, in allowing the Bills to proceed, every consideration would be shown to the firm by the promoters, in respect of compensation—whether it be as regarded their water requirements, or, if need be, by total purchase.

The Committee concluded the consideration of the Bills on May 23. Lord Methuen presided, in the absence of Lord Hawkesbury; and it was decided by the parties to proceed with a Committee of four peers only.

Mr. Baggallay brought up a clause to give effect to the suggestion of the Committee in regard to the Hey Head reservoir. The clause, he said, would give the owners of the Gale and Town House mills the compensation in water which was the maximum amount the petitioners considered they could give from the area, so as to have sufficient left for themselves for the purpose of their supply. If then the working of the mills was found to be interfered with, money compensation would have to be given. These two concessions were not to overlap. The arbitrator would first consider how much water the mills would require; then how much they got; and, finally, how much over and above that which they got they ought to have, and should receive money compensation for.

Mr. Wedderburn said that the circumstances of the case were very exceptional. The first thing that should be ascertained was the amount of water his clients used. To effect this, he would propose the insertion in the Bill of a clause similar to that put into the Malvern Link Bill of 1896. Under this, the amount of water would be decided by arbitration; Messrs. Mansergh and Wood acting as Arbitrators. The promoters in their clause would make the whole of the water pass Clough mill; whereas the petitioners proposed that only a portion of it should pass the mill and that the rest should come direct down from Stony Brook. Apart from this, the petitioners desired a special sub-section relating to the turbine, and their being deprived of the power of making extensions; and they thought there should be a clause to carry out the suggestion of the Committee, which was to the effect that if, in the end, it was found that, owing to the operations of the promoters the mills could not be carried on, the promoters should buy them out.

In reply, Mr. Baggallay admitted that the circumstances were exceptional; but he held that the clause he had proposed was exceptional. The usual form recognized in these cases was for compensation to be given by way of compensation-water—one-third of the collectable rainfall over an average of three dry years. The suggested clause was exceptional, inasmuch as having given the usual one-third, it went on to provide that this should not be deemed to be full compensation; but, there being exceptional circumstances, money compensation should be granted for any injury which compensation-water would not cover. In this respect, the clause was unusual. He considered that the promoters had made a very great concession. If, after all had been done, it was found that the mills had not sufficient water, the promoters would have to purchase. That would be the effect of giving compensation for the stoppage of the works. Under the clause proposed by the petitioners, the promoters would have to send to them all the water they got out of the stream *plus* that which was taken out of storage on the heaviest day they were working in the year. This would leave no water for the promoters themselves.

The Committee decided to adopt Mr. Baggallay's clause, with the addition after the words "compensation in money" of the words "including, if necessary, the total purchase of the said works." It was stated that the difference with the Todmorden Authorities had been settled; and thereupon the Bills were ordered to be reported to the House.

German Gas Coal for London.—It has been rumoured that part of the great contract of The Gaslight and Coke Company for coal would this year be placed in Germany. A trade journal, "Coal and Iron," states that the rumour is true, and that a quarter-of-a-million tons will be obtained from Westphalia. Durham coalowners sought an advance of 14d. a ton on account of the cost of the Workmen's Compensation Act and Explosives Order; and it is believed the German coal will be delivered cheaper in London than the North Country coal.

Extensions at the Skipton Gas-Works.—The Skipton Gas Company are making extensive alterations under the advice of their Consulting Engineer, Mr. R. Porter, the Engineer and Secretary of the Elland Gas Company. Contracts have been let for a new retort-house to contain 72 retorts, on Chester's regenerative system, complete with conveying and elevating plant to discharge canal boats, and place the coal in front of the retorts ready for charging. The Contractors for the work, including the roof, are Messrs. R. Dempster and Sons, Limited, of Elland.

The Price of Gas Coal Within a Ring.—A Wakefield contemporary says the Compensation Act has stimulated the colliery-owners to press for advances which, in the present weak state of the markets, they probably would not sustain under normal conditions. So far as the gas contracts are concerned, some of the South Yorkshire and North Derbyshire coal-owners have agreed to demand an advance of 9d. per ton within certain limits in which they have a better hold upon merchants. But outside the agreed limits, the same firms are offering at merely trifling advances; and in certain cases, at no advance at all. This action naturally prejudices the gas-coal collieries which are in the immediate neighbourhoods of the town where the competition is open. It is quite probable that the gas companies in a good area will resist any such attempt as that about to be made, nor does it seem just that they should be subjected to such terms as it is attempted to impose.

MISCELLANEOUS NEWS.

THE ACCIDENT FUND OF THE SOUTH METROPOLITAN GAS COMPANY.

Report on the First Six Months' Working.

The following report, signed by Mr. George Livesey, and dated the 25th ult., has been addressed to the members of the accident fund of the South Metropolitan Gas Company:—

The Workmen's Compensation Act of last year will come into operation on the 1st of July next. This Company's mutual accident fund is based on the experience of the previous five years, and was started in July last.

In 1891, the Directors resolved to make provision for all accidents; and from the beginning of 1892 an account has been kept of their number and cost. The allowance then fixed, and which has been practically adopted in the rules of the accident fund, was, for all accidents caused by the injured man's own negligence, the same pay as for sickness—viz., 12s. a week—and 18s. a week for all others. For all fatal accidents, widows and children were allowed from 15s. to 20s. a week for the first year or two, reduced ultimately to 10s. a week during life or widowhood.

At the end of 1891, four widows were pensioners. Since that year, ten fatal accidents have happened—viz., five in 1892, one each in 1893, 1894, and 1895, two in 1896, and none in 1897. The number of widows rose to fourteen in 1896; and at the end of 1897, twelve were receiving pensions.*

The fatal accidents during the last twelve or fourteen years have averaged about one a year.

During the five years 1892 to 1896, 553 accidents were reported; the highest number in any year being 137, and the lowest 80—an average of 110 a year, or about 3 per cent. per annum on the total number of men employed. The average duration of disablement or absence from work was almost exactly four weeks.

In the five years there was paid—

As accident-money	£1598
As pensions to widows	1439
Total	£3037

or an average of £607 a year. The highest amount paid in any year was £707. The whole was paid by the Company by increasing their subscription to the sick fund.

As nearly as can be ascertained, the number of men employed in a year was about 3600, which, at 1d. per week per man, would bring in £780 a year. Seeing that the total paid for accidents and pensions to widows never in any of the five years exceeded £707, the Directors considered that 1d. per week per man would be more than enough to cover all their liabilities under the new Act, and to pay the pensions in addition. They therefore fixed the Company's contribution to the fund at this rate, or rather at 1s. per quarter on the greatest number of men employed in any one week during the quarter. This is considerably more than 1d. per week for each man employed week by week.

The workmen were asked to pay ½d. per week, or 2d. per month; and all but one man agreed to do so. I am glad this man did object, because it proves conclusively that every man was perfectly free to act as he chose in the matter.

It was therefore hoped and expected that the united subscriptions would result in a considerable surplus to accumulate and form a reasonable reserve fund.

The first half-year's working of the fund shows the following results:—

The Company's contribution on the greatest number of regular and casual or odd men employed in any week in each quarter was—			
September quarter, 3611 men, at 1s. each	£180	11	0
December quarter, 4427 men, at 1s. each	221	7	0
		£401	18 0
The Workmen's contribution of 2d. per month per man, some of whom only joined the fund at various times after it was started, amounted, for 3815 men, to		167	16 0
Total receipts		£569	14 0
The outgoings were as follows:—			
For 15 accidents that happened before July 1, 1897, and received pay after that date	£79	19	0
For 119 accidents during the half year	271	2	0
Doctors' fees estimated at	36	16	0
Pensions to 12 widows	171	1	0
		558	18 0
Balance in hand only		£10	16 0

The half year, as shown above, paid £79 19s. on account of accidents that happened previously to men who had not recovered before the 1st of July. On the other hand, £49 1s. has been paid since Dec. 31 to 13 men injured during the half year who had not then, but have now, returned to work. Consequently, the actual money paid for all the accidents that happened in the half year was £320 3s.; and including doctors' fees, £356 19s.

The accidents are divided into three classes: Class A, receiving 12s. a week, being those injured by their own "gross negligence;" Class B, receiving 18s. a week, were "pure accidents;" and Class C, receiving 24s. a week, being those caused by "negligence on the part of the Company." They are classified either by the Accident Fund Committee or a jury of workmen.

Putting all together, the average period of disablement was 18¾ working days, or just over three weeks, for all the 119 men injured in the half year, including the time that passed before the 13 men above referred to returned to work. Of the 119 cases, 60 caused disablement for more than a fortnight; and in the remaining 59, the period of incapacity did not exceed a fortnight. In Class A, 6 men were incapacitated for more than two weeks; and 16 did not exceed a fortnight. In Class B, 54 men were incapacitated for more than two weeks; and 42 did not exceed a fortnight. The single accident in Class C only disabled the man for three days.

These particulars are given in order to show the amount of compensation that would have been paid under the "Workmen's Compensation Act." Under that Act, no compensation is payable for accidents caused by the injured man's gross negligence. Nothing is payable for the first fortnight in any case. The utmost amount that can be claimed is half wages, and that must not exceed 20s. a week.

Applying these regulations to the 119 cases, the average rate of wages paid by the Company is a trifle over 30s. a week. In order not to put it too low, 16s. a week may be taken as the average amount of half wages which could not be exceeded. Out of the 119 cases, all those under Class A, 22 in number, caused by the injured man's gross negligence, and 42 of those under Class B, and 1 in Class C, which did not cause more than a fortnight's disablement, could claim nothing under the Act. This leaves the 54 in Class B that could claim compensation at not more than 16s. a week on the average, after the first fortnight.

These 54 cases received, including doctors' fees, over £260, or an average of £4 16s. apiece. The average period of disablement was 4 weeks 5⅓ days.

Deducting the first fortnight, they would have been entitled, under the Workmen's Compensation Act, to an average of 2 weeks 5⅓ days' pay, which, at 16s. a week, would amount to £2 6s., or a total of £124 4s., which is, therefore, all that the whole of the men suffering from accidents which happened in the half year would have received under the Act. They actually received (including doctors' fees) from the mutual fund £357, or nearly three times as much as would have been paid under the Act.

The Company paid into the Fund in the half year		£401	18 0
They would have had to pay under the Workmen's Compensation Act	£124 4 0		
Add to this the amount paid in pensions to widows	171 1 0		
		295	5 0
This would have left a surplus from the Company's contribution alone of		£106	13 0

This £106 13s., in addition to the £167 subscribed by the workmen, has, all except £10 16s., been used to pay compensation over and above what would have been paid under the Act in the six months.

The great increase in the number of accidents requires notice. The number rose from an average of 110 a year to 119 in the last half year, or more than double the average number. In the three months ended in March last there has been a further great increase; the number of accidents for the quarter being 102. From the 31st of March to the 20th of May, 40 additional accidents have happened. In the five years, the accidents averaged 3 per cent. per annum on the number of men employed. In the first half year of the fund, it went up to 6 per cent. per annum. In the next three months, it rose to over 10 per cent. per annum, and has continued at about that very high figure.

Has there been any increase of carelessness? The danger of the work certainly has not increased. Under the new system, every accident, however trifling, involving three days' disablement, is reported and dealt with through the fund; whereas formerly some trifling accidents were not noticed, or came under the sick fund. The average period of disablement was less in the last half year than at any time in the five previous years. It has come down, in fact, from an average of four weeks to three weeks, which means a large increase of trifling accidents for which compensation is now claimed.

It will probably be said that a report based on only six months' working is unreliable, and that a much longer time is necessary to obtain fair average results; to which I reply that this depends upon the number of men. In our case, about 4000 men were employed during the half year, which is nearly the same thing as 400 men for five years, or 200 men for ten years, or 100 men for twenty years, which it may fairly be supposed would give a fair average of accidents. This is confirmed by the experience of the previous five years, when there were about 3600 men employed, and the number of accidents, year by year, was fairly regular; proving that with 3000 or 4000 men a reliable average of the number of accidents to which they are liable can be ascertained in a short period.

The experience of the past half year, when compared with the previous five years, raises the question: What is an accident? One answer would be: Whatever injury, however caused, other than sickness, that incapacitates a man for however short a time. If this rule is followed, a simple cut finger and such trifles will be classed as accidents, and the number will be enormous. In our case, since July last every injury causing not less than three days' incapacity has been so classed, and has received compensation as such.

This consideration points to the necessity for some definition and classification of accidents. It certainly does not seem right or fair that, under our present rules, a man who receives a trifling injury, sometimes from his own carelessness, which prevents him following his employment for a few days, should, in return for his ½d. (halfpenny) a week subscription, receive accident pay at the rate of 18s. a week, while a payment of 3d. a week to the sick fund provides but 12s. a week during sickness.

I expected the strict working of the new rules would bring to light all the accidents; but I certainly did not expect a large increase. I hoped that the establishment of the mutual fund would lead to greater care on the part of the men generally, and a consequent reduction in the number of accidents. I think I may say that all who were engaged in starting the accident fund hoped that the contributions would be more than sufficient, and that a substantial reserve fund would soon be accumulated. So far from this being the case, there is an actual deficiency of £112 in the accounts for the first three months of this year. Some alteration must, therefore, be made to stop this great increase of accidents, which is the most serious part of the question; otherwise the mutual fund will have to be dropped, and the Company will then fall back on the Act, which, as shown above, provides for less than half of the accidents and only one-third of the amount of compensation. The Profit-Sharing Committee will be asked to deliberate upon the question, in the hope that some means may be found to continue the mutual fund, and to put it upon a just and satisfactory footing.

[A list of all the accidents of the half year is appended to the report.]

* Under the Employers' Liability Act, not more than two or three of these widows would have received anything.

THE REPORT OF THE CHIEF INSPECTOR UNDER THE ALKALI ACTS.

The report of the Chief Inspector under the Alkali, &c., Works Regulation Acts, 1881 and 1892 (Mr. R. Forbes Carpenter), for the past year was issued last week. It opens with a notification of the resignation by Mr. B. E. Smith of his sub-inspectorship, and the appointment of Mr. J. W. Young, B Sc. (Lond.), to succeed him in the charge of the district comprising the Northern Counties of England. Mr. Jackson, who supervised the South Midland district, met with a serious accident at the close of 1896, which incapacitated him from active duty for nearly eleven months. His work was undertaken by several of his colleagues; but he was able to resume his duties in November.

Passing on to deal with the work carried out last year, the Chief Inspector says the number of works now registered in England, Ireland, and Wales is 1058. Of these, 87 only are works decomposing salt, and so scheduled as alkali works; while the remaining 971 carry on processes which are scheduled under the Acts of 1881 and 1892. These numbers show a decrease of 11 alkali works and 5 others since 1896. There are also 125 works registered in Scotland; bringing the total up to 1183. Concerning these a separate report is, as usual, presented to Her Majesty's Secretary for Scotland. The number of processes under inspection last year was 1479, as compared with 1505 in 1896. In the treatment of gas liquor, 42 were employed—the same as before; and in sulphate of ammonia manufacture, 379, or one less than in 1896. There were 4116 visits paid to works, and 4562 tests made; the figures for 1896 being 5162 and 4775. The gases escaping from the sulphuric acid chambers as sulphur trioxide amounted to 1·184 grains per cubic foot, as compared with 1·210 grains and 1·158 grains in the two preceding years. The acidity of all chimneys, given as sulphur trioxide, was 0·788 grain, against 0·803 grain and 0·709 grain.

There were three prosecutions under the Acts last year; clause 9 of the Act of 1881, which makes it obligatory on manufacturers to use "the best practicable means" for preventing the escape of noxious gases, or for rendering them harmless and inoffensive when discharged, entering into them all. In the first case, the proceedings were closed by payment of the maximum penalty named in the clause (£20) before the matter came into Court. The second case was that of the Commercial Gas Company, the proceedings in which were fully reported in the "JOURNAL" at the time (see Vol. LXX., p. 51). The third case related to a tar distiller in Cork. Mr. Carpenter says the circumstances connected with these two cases demand more notice, especially as, through the adjournment by the Courts of the proceedings in each of them, it has been possible to arrive at an amicable settlement of the points in dispute. The facts in connection with the Commercial Gas Company are given as follows:—

Mention has been made in the reports of my predecessor, Mr. A. E. Fletcher, that the time had arrived when the method of combustion of the sulphuretted hydrogen evolved in the manufacture of salts of ammonia from gas liquor, and of its subsequent discharge into the air as sulphurous acid, could not, for the works of large size, in the light of the experience that had been gained since 1882, be considered as a satisfactory fulfilment of the obligations enjoined by the Act of 1881, that "the best practicable means shall be used for preventing the discharge into the atmosphere of all noxious gases and of all offensive gases evolved in such work, or for rendering such gases harmless and inoffensive when discharged," &c. During the autumn of 1895, the Commercial Gas Company, in compliance with an undertaking given to my predecessor, laid down a pipe to convey these foul gases arising from their manufacture of sulphate of ammonia at Stepney to a works where they were utilized in the manufacture of vitriol; and on the success of his method being proved in 1895-6, it became my duty to call upon the Company to fulfil their obligations also as regards the Poplar works—the larger of their two stations. These negotiations resulted in arrangements being made to send the gases from Poplar to the same vitriol work, lying as this did between the Stepney and Poplar stations. The pipe, however, when laid, was never used for the purpose of conveying gases, but on completion was put to the use of conveying gas liquor from Stepney to Poplar, where the whole of the ammoniacal liquor made at the two stations has since that time been converted into sulphate. On my being made acquainted, at the close of 1896, with these facts, and learning also from the Company that they had decided to erect vitriol plant at Poplar, it became my duty to consider whether it was not possible, until the vitriol plant were completed, to which the gases would ultimately be drafted, to adopt some easy means of dealing with the large quantity of sulphurous acid discharged into the air by the somewhat low chimney at Poplar; and, through the courtesy of the Oldbury Alkali Company, I was enabled to put before the Commercial Gas Company the method that had been in successful use at Oldbury for several years previously, of neutralizing the acid escape by passing the gases up a tower filled with limestone, and fed with a flush of water—the amount of sulphurous acid to be dealt with being about five tons weekly. Although my proposition was accepted, no active steps were taken to carry it into effect; and at length it became my duty to apply to the Board for permission to institute proceedings against the Company for recovery of penalties under clause 9. The hearing of the case, however, did not commence till more than three months later—June 28—within which period progress was made, not only with the vitriol chamber, but also with the erection of a limestone tower. After hearing evidence as to the discharge of sulphurous acid (from a chimney 60 feet in height, in quantities of 2·75 to 4·25 grains per cubic foot, as SO^3), and to the "harmfulness and offensiveness" contributed by Dr. John Tatham, late Medical Officer of Health for Manchester, and now Superintendent of Statistics in the Department of the Registrar-General; Dr. Arthur Ransome, F.R.S., who has devoted much attention to acid impurities in the air as affecting health and disease; Professor J. R. Haldane, F.R.S., on the physiological action of sulphurous acid on the human organism; and by Professor W. Ramsay, F.R.S., on the more purely chemical and physical side of the question, the official evidence of Mr. A. E. Fletcher and myself was taken. At the close of the latter, on July 1, the Court made inquiry from the representatives of the Commercial Gas Company as to the time required to complete the works; and an undertaking having been given that the vitriol plant should be completed to the satisfaction of the Department within four months from July 1, and the limestone tower be put into operation within a week, the case was adjourned by the Court for four months. Subsequently, further adjournments, amounting to a month, were agreed to, the vitriol plant not being quite complete; and the case is now discharged from the list. The guarantee given to the Court, though refused to the Department, enabled an automatic settlement of the disputed points to be arrived at. Although no authoritative pronouncement was made which would serve as a precedent for the future in dealing with similar cases of failure to use "the best practicable means," yet at the close of the case the Court intimated that, by the yielding of the defendants, the Department had practically got its precedent in regard to other works.

The case of the tar distiller is not of special interest to "JOURNAL" readers.

Sulphate of Ammonia Manufacture.

The portion of these annual reports in which sulphate of ammonia is dealt with is always of considerable interest; and the one under notice does not show any falling off in this respect. In the two preceding reports, particulars were furnished of the experimental working of oxide of iron purifiers with concurrent revivification by the admission of regulated steam and air. Mr. Carpenter now gives in tabular form the results of analysis of the sixth run of the Flitwick oxide in the purifier at the Luton Gas-Works, and of a sample received from a works in Scotland, using Irish bog ore which had been employed for three runs. The results compare fairly with those obtained at Luton, as regards the proportion of free to total sulphur at the same stage of saturation. The seventh run of the Flitwick oxide was the final one before the sale of the purifier's contents; and the average sample of the two tiers showed 49 per cent. sulphur in the dried sample. An analysis of the oxide to take its place was made; and it showed that there already existed combined sulphur insoluble in water or dilute acids (possibly as calcium sulphate) in the material before use. One-fifth of this mixture is artificial oxide.

Purifier No. 2.—Flitwick Oxide.

—	Fifth Run, Nine Days.			Sixth Run, Twelve Days.			Seventh Run, Ten Days.	Remarks.	Virgin Mixed Oxides. Four Parts Irish Bog Ore to One Part of Artificial Ground Oxide.
	Bottom Tier.	Top Tier.	Average.	Bottom Tier = Top Tier Fifth Run.	Top Tier = Bottom Tier Fifth Run.	Average.	Average Mixed Samples.		
	Per Cent. Dried.	Per Cent. Dried.	Per Cent. Dried.	Per Cent. Dried.	Per Cent. Dried.	Per Cent. Dried.	Per Cent. Dried.		Per Cent. Dried.
Sulphur extracted by carbon disulphide	41·03	45·59	43·31	51·60	45·30	48·45	49·00	During the sixth run the supply of air was increased, and the steam reduced.	..
Sulphur as sulphates soluble in water	2·66	1·94	2·30	2·08	1·80	1·94	..		0·90
Sulphur extracted by dilute acid, after treatment with water	0·35	0·59	0·47	0·16	0·70	0·43	..	No firing took place either in the purifier, or when the oxide was thrown out.	0·00
Sulphur in other forms of combination by difference, partly FeS_2	2·83	1·95	2·39	3·21	3·10	3·16	..		0·57
Total sulphur	46·87	50·07	48·47	57·05	50·90	53·98	..		1·47
Proportion per cent. of free to total sulphur	87·50	91·00	89·40	90·40	89·00	89·70	..		..

Irish Bog Ore.

Third Run.	Per Cent. on Dried Sample.
Sulphur extracted by carbon disulphide	26·00
Sulphur as sulphates soluble in water	0·75
Sulphur extracted by dilute acid after treatment with water	0·0
Sulphur in other forms of combination by difference, partly FeS_2	2·80
Total sulphur	29·64
Proportion per cent. of free to total sulphur	87·7

Remarks.—This supply of steam and air is regulated by a thermometer placed in a tube going down to the first or lower of the two tiers of oxide

When 190° Fahr. is reached, the steam is increased and the air supply decreased. Each of the two purifiers works twelve hours at a time; and the oxide is changed about every nine to ten days. In the twelve hours, when not working, first steam and very little air are put on for two hours; subsequently the air is increased and the steam decreased. There are 16 to 18 inches depth of oxide on each tray.

The Chief Inspector remarks that in several works where the continuous process of distillation is in use, attention is being paid to a method proposed as an alternative to oxide of iron purification where the output is too small to make the Claus process available, and where the disposal of the gases by vitriol plant is impossible. This has been in use for some years at works in the South Midland district, and is, he says, likely to receive further extension. The gases, after being subjected to thorough condensation to remove aqueous vapour, pass to a furnace designed especially to act as an accumulator of heat, where complete combustion of the sulphuretted hydrogen to sulphurous acid is effected. With gases containing 20 per cent. by volume of H^2S, the flame of a large gas-jet is sufficient to initiate and maintain combustion at the end of the pipe bringing the foul gases to the furnace; the reaction being made complete by the prolonged travel of the gases over the surface of bricks and tiles kept at a bright red heat. Provision is made for supplementary air being admitted at various points in the furnace, so that no vapour of sulphur may pass unoxidized. After subsequent cooling to atmospheric temperature, the gases pass to the bottom of a tower packed with limestone, and fed on the top with a shower of water. Under these conditions, the acid enters into combination with the base of the limestone, and issues from the bottom of the tower in solution as bisulphite of calcium.

Mr. Carpenter draws the attention of those using the Claus process of sulphur recovery in dealing with the foul gases evolved in sulphate manufacture to the fatality at the Colne Corporation Gas-Works in December last year, and to the circumstances attending it. These were briefly noticed in the "JOURNAL" at the time, and are more fully described in one of the District Inspectors' reports, to be dealt with in a subsequent issue. The dependence on screw-down valves is shown to be attended by grave risks that can be avoided by simple means, though in this instance there was no proof that the gases made their way back.

Having given the results of an examination of ammoniacal liquors, from various sources, in continuation of previous tabulated particulars, the Chief Inspector passes on to the subject of the recovery and production of ammonia. Through the courtesy of manufacturers, he is able to continue in the following table the information presented, as in former years, of the total produce of ammonia in all forms in the United Kingdom, and calculated on the basis of the salt most commonly manufactured—viz., the sulphate of ammonia.

	1897. Tons.		1896. Tons.		1895. Tons.
Gas-works	132,724	..	127,498	..	119,645
Iron-works	17,779	..	16,511	..	14,588
Shale-works	37,153	..	37,822	..	38,335
Producer gas, coke, and carbonizing works . . .	10,624	..	9,078	..	7,083
Total	198,280	..	190,909	..	179,651

Mr. Carpenter remarks that it is hardly necessary, perhaps, to repeat the warning conveyed last year—that these figures only relate to production, not to what is marketable. Ammonia in the hydrated or anhydrous form enters largely into use in the manufacture of other chemical substances, notably into that of cyanides for gold extraction. He expresses his pleasure, remembering the insistence of the late Dr. Angus Smith on the national importance of the subject, in noting the increasing attention that is being paid, in the manufacture of metallurgical coke, to the recovery of residuals, extended, as it has been, to other chemical substances since Dr. Smith wrote on this industry, in which ammonia forms one, but not the most important, item. Mr. J. H. Darby, of Brymbo, has kindly placed at his disposal the results which can be obtained by efficient ovens and recovery plant, and which, stated as values at present prices from a unit of fuel treated, show that 68 per cent. value of coke is obtained, 5 per cent. of tar, 9 per cent. of ammoniacal liquor (in terms of sulphate), and 18 per cent. of light oils, chiefly benzol, resulting from depriving the gas of the more volatile hydrocarbons it contains by scrubbing through heavier oils. Mr. Carpenter says that "after a careful comparison of the relative illuminating values of the gases from fuel coked in the Semet-Solvay ovens at Brymbo with that of similar fuel treated in gas-retorts, it was found, by the observations of an experienced technologist in gas manufacture, that the multiple, illuminating power × cubic feet per ton, was for the former about 160,000, compared with 185,000 in the case of gas-works. (The test was made at a time when the gas yielded by the ovens was from 5 to 10 per cent. below its normal quantity.) Looking, however, to the superior value of metallurgical coke obtained, the conclusions I stated in last year's report appear to be justified. The calorific value of the Brymbo coke-oven gas is receiving further investigation." He adds that in Yorkshire and Lancashire, as well as in Durham, where plants previously existing are receiving extension, and also in Scotland, the year 1898 will see the addition of recovery plants of various systems; good progress towards completion having been made during the year under review.

The Chief Inspector learns from the best sources of information open to him that, while the efforts made in this country to show the true value of sulphate of ammonia in comparison with nitrate of soda in agriculture have been continued and widened, the increase in 1897 in the home consumption of the former, as far as this can be correctly ascertained, was only 2000 tons, while France took from us 10,000 tons more in the same period, and Germany and Belgium together nearly 12,000 tons more. The total amount of sulphate used for all purposes in the United Kingdom was about 70,000 tons. Continental production continues to augment, but not at the rapid rate witnessed in 1894, 1895, and 1896, largely due to the extension of coke-oven recovery plants. In France there was an actual decrease in production.

Opportunity presented itself during the past year of watching the tar-distillation process from starting to the end of the anthracene stage, when oil was added to soften the pitch before running to the cooler. The results obtained of an examination of the worm-end gases are given in tabular form. They show that while any water remains in the still under examination, the amount of sulphuretted hydrogen escaping is small; the smell of bisulphide of carbon being more pronounced. As a rather large proportion of condenser tar is included in the working, the quantity of ammoniacal water is larger than usual. Directly this ceases to come over in the distillate, the sulphuretted hydrogen goes up, and remains at a very steady figure throughout the subsequent processes till the anthracene stage ends. The permanent gases are shown to have strong heating capabilities on combustion. Three fatal accidents occurred in works of this class; two being explosions. The first case was a still worked in the previous operation as an oil-still, and then made up for a further distillation with fresh tar; in the second, no tar was being distilled, but oils produced in previous distillations of tar. The evidence in both these cases suggests that greater precautions in the use of safety-valves or pressure indicators and thermometers are, in many instances, necessary. The third accident occurred while a still was being cleaned of adhering deposit; and Mr. Carpenter repeats the warning conveyed to manufacturers in the report for the year 1894 of the necessity of physical disconnection of the stills, when under cleaning or repair, from other stills working in the series. In this case a water-seal existed, and a separate foul gas ejector for each of the two stills. If the foul gas and pitch-pipe branches had been disconnected and the ejector put into action, there could have been no possible return of foul gas, and the supply of fresh air would have been maintained.

The reports of the District Inspectors contain much interesting matter, which must be left for notice in a subsequent issue.

GAS AND ELECTRIC LIGHTING IN MASSACHUSETTS.

We learn from the thirteenth annual report of the Massachusetts Board of Gas and Electric Light Commissioners, some extracts from which have been given in previous issues of the "JOURNAL," that there were under the supervision of the Board at the commencement of the year 134 companies and the gas or electric light plants of 13 towns and 2 cities. Of the former, 45 are engaged in the supply of gas solely, 24 in the supply of both gas and electric light, and 65 provide electric light only. Of the municipalities, two have plants for producing gas and generating electricity; the others furnish only the electric light. During the past year, four companies were chartered with gas or electric lighting powers; the total capital amounting to $142,000. Water gas, either alone or in combination with coal gas, is now distributed in 26 towns. The Massachusetts Pipe-Line Gas Company, incorporated in 1896, was organized on the 15th of July in that year—the capital being fixed at 10,000 shares of the par value of $100 each; but no business was transacted. The Company are authorized to sell gas to any gas company, and to make a contract for such sale "for such term of years, and on such conditions, as may be mutually agreed upon," subject to certain limitations as to price. Acting under this power, the Company have contracted with the Boston Gas Company and several others for a term of fifty years in each case. Under these contracts, the Boston Company are to purchase, in equal daily proportions, not less than 146 million cubic feet of gas per annum, and the others not less than 36½ million cubic feet each annually, as soon as the Pipe-Line Company are able to supply. It is provided that directly this Company shall have command of gas in sufficient quantity to warrant them in notifying to any of the Companies that they are prepared to supply such Company with all the gas they need, notice to this effect may be given; and at the expiration of three months the Company are to buy all the gas of the kind described which they can use. The gas to be provided by the Pipe-Line Company is to be of not less than 12-candle power, purified in accordance with legal requirements, and capable of enrichment to a merchantable gas of 25-candle power if for illuminating purposes, and to have not less than 580 British thermal units per 1000 cubic feet if for purposes of fuel or motive power. No provision has yet been made by the Company for manufacturing gas; and apparently they do not intend to carry on this branch of the business, as they have contracted to purchase from the New England Gas Company all the gas they may require for a term of fifty years. No request has been made to the Board by the Company for their approval to an issue of stock. The New England Company are an unincorporated voluntary association, the affairs of which are managed by a Board of Trustees. The capital consists of 200,000 shares, of the par value of $50 each. The Company have executed a mortgage to secure their bonds for the total amount of $17,500,000 par value to the Central Trust Company of New York. Of this total, $14,000,000 is to be issued at once on the security of certain properties specified. The bonds will bear interest at the rate of 5 per cent. per annum, and will mature on Dec. 1, 1937. The Commissioners say it is difficult to fully appreciate the importance and probable results of these transactions; but one purpose of the Company would seem to be to offer to the public upwards of $27,000,000 of new securities free from the restrictions and supervision imposed upon regularly incorporated companies engaged in a kindred business. They call attention to these facts as constituting a notable evasion of existing laws passed for the mutual protection of the investor and consumer; and they suggest that, if its repetition is to be prevented, some additional legislation will be necessary.

Turning to the statistical portion of the report, we find that the receipts for the year ending June 30, 1897, were $6,046,747, as compared with $6,043,652 in 1895-6. The sale of gas by meter produced $5,514,936, against $5,517,061 in the preceding year. The expenditure came to $4,140,763, as compared with $4,219,254 before. There was consequently an apparent net profit of $1,905,985; but this sum was increased to $2,597,029 by amounts received for interest, rents, and profits from electric lighting. After payment of the interest on bonds and loans, dividends, &c., amounting to $2,080,386, there was a surplus on the year's working of $516,643, as compared with $358,198 before. The receipts from gas sold by meter show a decrease of $2125; whereas in the preceding year there was an increase of $737,240—being the largest in any year since the returns have been made. Though the quantity of gas sold for public lighting was greater last year than before, the income was smaller by $1342; showing an appreciable reduction in the average price of gas supplied for this purpose. The total amount of dividend declared was $1,412,404. One of the companies did not cover expenses; while seventeen others did not earn sufficient to warrant the declaration of a dividend. The maximum return was 13 per cent.; the minimum 3 per cent. The price of gas was reduced

in 22 places last year. The average paid by consumers for coal gas to the companies selling annually more than 30 million cubic feet each was $1·10 per 1000 cubic feet. Excluding the Boston and Brookline Companies, the average was $1·18. The average price received by the remainder of the coal-gas companies from sales by meter was $1·69; the average received by all was $1·15. If the quantity sold by the Bay State Company to other companies is included in the computations, the average for all the companies comes to $1·03; and for those selling more than 30 millions per annum, to $0·9823. The average price for oil gas is $3·96 per 1000 cubic feet. There are 25 companies supplying water gas; and 8 selling oil gas. In the manufacture of the former, the material used in the generator is mostly anthracite; the enricher being naphtha or gas oil. Naphtha is used exclusively for the production of oil gas in three cases, gas oil in three, naphtha and gas oil in one case, and petroleum in one. During the year, about 107 miles of mains were laid. The total number of meters in use on June 30 last was 174,223, representing a nominal capacity of 1,107,733 lights; being an increase of 7928 meters and 33,759 lights as compared with the previous year. High-power lamps continue to be largely in use; and the Welsbach system is increasing in favour. There were 4814 incandescent gas-lights at Lawrence, 3956 at Holyoke, 3000 at North Adams, 2630 at Cottage City, 2007 at Gloucester, 333 at Easthampton, and 300 at Amesbury on June 30, 1897. A table is given showing the number of gas-stoves in use on that day. Brookline heads the list with 19,932; Boston follows with 13,833; while Roxbury, Dorchester, Springfield, and South Boston have 8669, 7134, 3735, and 3464 respectively. In five towns the number of stoves in use is less than ten. With regard to public lighting, there was an increase of 194 gas-lamps at Dorchester; and smaller additions were made in 12 other towns of the 35 making returns. There was a decrease of 77 gas-lamps in those towns, and of 10 oil-lamps at Amherst.

In the portion of the report dealing with electric lighting, we find the following results of the operations of the central stations in the State for the year ending June 30, 1897: Receipts for electricity supplied for light and power, rent of motors, meters, &c., $4,510,134; expenses, $2,888,477—leaving an apparent net profit of $1,621,657, compared with $1,447,477 in the preceding year. Of this profit, the gas companies made $228,738 in their electrical departments. So that the electric light companies made $1,392,919. To this should be added the income from rents, jobbing, &c., amounting to $96,745; making altogether $1,489,664, as compared with $1,436,890 in 1895-6. Against the former amount have to be placed the charges for interest, dividends, depreciation, &c., $1,171,505; leaving a surplus for the year of $318,159, as compared with $34,890 in 1895-6, and a deficit of $182,249 at the close of the preceding twelve months. Three of the companies do not appear to have earned their expenses; while 32 others did not earn sufficient to warrant the declaration of any dividend. The gross profits of the companies doing only an electric business increased last year by $52,774; and though interest charges increased, dividend and depreciation charges decreased. The net result of the year's operations is the largest surplus of any year since the business began. Particulars are furnished as to the systems employed by the companies, the maximum dynamo capacity stated in lamps of certain nominal candle powers, and the capacity of the generators in operation on June 30, 1897; also the length of wire and underground conduits, the number of poles set, and the length of streets with overhead wires of each company; the number of motors furnished on arc, incandescent, and power circuits; the number of commercial lights of the different kinds installed, and of customers; the number of public lamps of each candle power, the price paid for them, and the hours they were run; and, finally, the prices charged by the several companies.

As usual, the report contains an account of the accidents resulting in death or bodily injury, from gas or electricity, which were brought under the Commissioners' notice in the twelve months covered by their report. There were 105 different instances of escaping gas, causing the death of 60 persons and injury to 74 others. These are exclusive of the explosion of gas at the corner of Tremont and Boylston Streets, Boston—known as the "subway explosion"—whereby 10 persons lost their lives, and, as the Commissioners were informed, 72 others were more or less injured. An account of this accident has already appeared in the "JOURNAL" (see Vol. LXIX.); and a special report thereon is given as an appendix to the report under notice. Of the 60 fatal cases recorded, the Commissioners state that 18 were clearly suicides; while of the other 74, self-destruction was apparently intended in nine. Of the fatal cases, 45 occurred in Boston; and 56 of those which did not so terminate were in that city. There were eight fatal and fourteen non-fatal accidents from electricity. Particulars of all the cases are given. In the previous year, the number of escapes was 761, which caused death in 51, and injury in 118 cases; while electricity was answerable for seventeen accidents, which resulted in the deaths of five persons and injury to twelve others.

Two of the appendices to the report deal with the subject of the supply of water gas and coal gas in Boston, with special reference to the possible danger arising therefrom. This matter has already been fully noticed (*ante*, pp. 842, 896).

In addition to the report above noticed, we have received that of the Inspector of Gas and Meters (Mr. C. D. Jenkins), which furnishes the following particulars as to the work of his department in the past year. There were in all 645 inspections of gas, and 23,127 testings of meters in the twelve months ending Dec. 31, 1897. The average illuminating power of the gas supplied by the 36 coal-gas companies was 17·92 candles; that supplied by the 16 water-gas companies, 23·66 candles; that sent out by the mixed coal and water-gas companies, 19·79 candles; and that of the 7 companies supplying petroleum gas, 38·11 candles. With regard to purity, sulphur averaged 9·54 grains per 100 cubic feet; and ammonia, 2·29 grains. Of the 23,127 meters tested, 22,684 were either new or repaired; and they were presented by the manufacturers or gas companies for inspection. A number of prepayment meters were tested. In accordance with statutory requirements, 443 meters were re-inspected last year. Of this number, 9 would not register; 220 were correct; 183 were fast; and 31 were slow—the total average error of the registering meters being 1·36 per cent. fast. In 1896, of the 1200 meters tested, 477 were fast, 113 slow, and 602 correct; the average error of the registering meters (1192) being 1·22 per cent. fast.

ELECTROLYSIS OF GAS AND WATER MAINS.

Report by the Glasgow Electrical Engineer.

The above-named subject came before a Special Sub-Committee of the Gas and Water Departments of the Glasgow Corporation, at a meeting held on the 20th ult. A report upon it had been called for from the Electrical Engineer (Mr. W. A. Chamen); and he presented it as follows:—

To the Special Sub-Committee of the Gas and Water Departments.

Gentlemen,—In accordance with your instructions to consider and report as to the prevention of electrolysis along the Springburn Electric Tramway route, I beg to submit the following report.

I have made a careful examination of the system of banding the rails together, and have also made electrical tests of the resistance of the rails themselves, by passing heavy currents through and measuring the fall of potential in them. I find that the electrical resistance of the steel rails is about ten times that of pure copper of equal section; or, in actual figures, the resistance of 42 feet of rail is 0·0003575 of an ohm. The sectional area of the rails is 10 inches. The resistance of the copper bands, including the points of junction or contact with the rails, measured with two bands in parallel, as they are actually being laid, averages 0·000066 of an ohm.

The length of the line from Springburn to Mitchell Street is about 13,400 feet. The rails measure 45 feet from end to end; and there will therefore be 300 rails to each line of each road. Only 43·66 feet of each rail can be relied upon to carry current; and the bands bridging over the fish-plates will be responsible for carrying the current for the remainder of the distance. The total resistance of one rail only, from end to end of the line, including bands, will, therefore, be 0·13127 of an ohm. As there are four rails, which are cross-coupled in parallel about every 135 feet, the total resistance of the whole line of double track will be 0·03282 of an ohm. It is difficult to estimate the amount of current which these rails may be required to carry; but, with 20 cars running on this route (this being the number which the Tramway Department inform me they propose to run), I think that an average current of 25 amperes per car throughout the route will be somewhere about what will be found to be required in working.

The tramway generating station is not at the extreme end of the Springburn route, but some 2300 feet on the homeward side of it. The resistance of the line from this point to the terminus in Mitchell Street will be about 0·0278 of an ohm; and the current which will have to be carried by the rails along this portion will be about 400 amperes. The whole of this current will not, of course, be carried throughout the entire length, but it will be used by cars distributed at approximately equal distances throughout the route. Taking this into account, the fall of potential between the tramway in Mitchell Street and the generating station will be about 5·56 volts.

The Board of Trade regulations, issued on March 6, 1894, are very stringent, and provide for the regular testing and record of the number of cars running, the maximum working current, the maximum working pressure, the maximum current for the earth connections, leakage current, and the fall of potential in the return—that is to say, in this case, in the rails. Clause 7 of these conditions requires that, if at any time such difference of potential exceeds the limit of 7 volts, the Company—that is to say, the undertakers—shall take immediate steps to reduce it below that limit. I understand that the Tramway Department are not putting in any return feeders to assist in carrying back the current at present; but if the Board of Trade limit of 7 volts should be exceeded, they will doubtless be able to put in a return feeder in one of the six pipes which they are laying beneath the tramway. Provision is also made in these regulations for limiting and ascertaining the amount of current which may return to the generating station through the earth, or by any other channel than the rails themselves; and somewhat elaborate conditions are set out for the purpose of enabling the owners of any pipes to ascertain, at any reasonable time, that the conditions laid down are being complied with.

Turning now to the actual construction of the bands, and the probability of their maintaining good connection with the rails, I would draw your attention to the sample band in a piece of steel plate, which has been cut open in order to show in section how the contact is effected, and also to the two sample bands. The copper band is about 28 inches long and 0·46 inch in diameter. It is forged at the end to form a boss about $\frac{7}{8}$ inch in diameter and $\frac{9}{16}$ inch in depth, with a shoulder on one side. The boss is punched through the centre with a tapered punch, the hole measuring $\frac{1}{2}$ inch at the large end—that is to say, in the shoulder. The hole in the rails is made a good fit for the boss by means of a reamer having a slight taper. This operation is performed immediately before the band is inserted; care being taken to have the larger end of the hole on the side of the rail away from the shoulder of the band. The boss of the band is, before insertion, carefully cleaned with a smooth file. When inserted in place, a drift is driven through, to expand the band tightly into the hole, and also to prepare the way for the permanent steel pin, which is then driven right home, so as to be flush with the upper boss at both ends. In driving in the drift and the steel pin, the far end of the boss is considerably expanded outwards over the edges of the hole, so that it is impossible for it to draw out. In addition to this, the taper of the hole itself is in such a direction as to resist the withdrawal of the boss, even if the outer end were cut off. I think this method of banding rails will prove entirely satisfactory, and do not at all expect that there will be any trouble whatever through their working loose. In some forms of band, the pin or key is driven in from the opposite side of the rail to that on which the band itself lies; thus necessitating holding up while the operation is performed. But with this type of band, the action of driving in the drift and the pin forces the shoulder hard home to its proper place.

Each joint is, after completion, carefully painted over with a preservative compound to prevent corrosion and the entrance of moisture to the surfaces; and it might, perhaps, be an advantage to treat the whole band in the same manner, in order to reduce to a minimum all chances of corrosion. I do not think, therefore, that, so long as the limit of 7 volts fall of potential between the most distant points on the line and the generating station is not exceeded, there will be any fear whatever of electrolysis of gas or water mains. In all those cases in which trouble

has occurred, the fall of potential over the rails has far exceeded this limit; being as much as 50, or possibly 100 volts.

(Signed) W. A. Chamen.

The Special Joint Sub-Committee, having considered the report, and received verbal explanations from the Electrical Engineer on the subject-matter thereof, resolved as follows: "(1) To report that, if the Tramways Department observe and carry out all the rules and regulations of the Board of Trade with respect to the construction and maintenance of the electric tramways on the Springburn route, there does not appear to be any danger of the gas or water mains and pipes laid along the route being injuriously affected by electrolysis from the action of the return currents along the tramway rails or otherwise; and (2) that the Electrical Engineer should report to the Engineers of the Gas and Water Departments respectively any further facts or circumstances which may from time to time hereafter come to his knowledge in regard to any of the matters dealt with in his report."

THE PRICE OF GAS IN LEEDS.

At the Meeting of the Leeds City Council last Wednesday, Mr. Herbert Brown moved that a resolution of Oct. 9, 1895, as to the price of gas, be rescinded, and the charge to consumers within the city be reduced on and after July 1 next from 2s. 2d. to 2s. 1d. per 1000 cubic feet. Briefly reviewing the past eighteen years, the mover said that 1s. 10d. was the price from 1880 to 1890, when a deficiency gradually crept up. In 1891 the Committee increased the price to 2s. 2d. to remove the deficiency. But still there was a loss; and the charge was in January, 1895, raised to 2s. 4d., only, however, to be lowered to 2s. 2d. in 1897. The profits of the last three years were: 1896, £26,495; 1897, £7133; 1898, £12,232. What, he asked, had become of those profits? Out of the total of £45,858, £27,000 had been handed over to the city fund. He understood there was an intention of reducing the price by 2d.; but it could not be considered until the wage question was settled. The reduction he proposed would mean £10,000; and he argued that it would be covered if this year they made the average of the profits of the past three years. Mr. Leuty seconded the motion, though he said he would prefer to see a reserve fund of £50,000 before the price was altered. Mr. Batley suggested going back to the old price of 1s. 10d. Alderman Gordon remarked that they never made gas at 1s. 10d., although it was sold at that price. Mr. Lowden thought there was little need for him to reply to Mr. Brown, who had passed a eulogy upon the gas-works management. The enterprise of late had certainly been great. Within the past three years, a reduction of £18,000 had been made; and by the abolition of meter-rents, £29,000 had gone out of revenue. Comparing the cost of coal at the present time with that when gas was sold at 1s. 10d., he found a difference of no less than £17,000 a year. The average price of coal during the nine years that gas was at 1s. 10d. was 8s. 3d. per ton; and the cost last year was 9s. 2d. For the profits made, he gave credit to those who had charge of the arrangements more than to the newer appliances introduced. He hoped the time would come when the Committee would be able to recommend a reduction in the price. He would certainly take the earliest opportunity of doing so. The present, however, was a most inopportune time; and the resolution was altogether unreasonable and untimely. Two important questions he would ask the Council to bear in mind. In the first place, the revenue from residuals was one that fluctuated very much from year to year, and was attended with great complications. In 1895, the income from residuals was £65,915; while in 1897 it was £54,713, or a decrease of £11,202. It was therefore impossible to say what the price of residuals was going to be during the next twelve months. For this reason alone, it was desirable that the Committee should have a surplus in hand. But there was another cause for holding their hand at the present time. There were rumours of Yorkshire miners demanding an advance of wages; and if this led to such an unfortunate rupture as occurred a few years ago—when the estimated additional cost of coal was £24,000—the extra expenditure that would be thrown on the Committee would be very great; for if difficulties arose they might have to pay a larger sum of money for coal not so well adapted for gas producing. In view of all these contingencies, it would be well for the Council to wait. By doing so, they would best consult the interests of the consumers of gas, of the ratepayers, and of the Committee's workmen. The motion was defeated by 27 votes to 15.

LANCASTER CORPORATION GAS AND WATER SUPPLY.

At the last Meeting of the Lancaster Town Council, the report of the Gas Engineer (Mr. C. Armitage), which was noticed in the "Journal" for the 31st ult., came up for consideration with the minutes of the Gas Committee. In moving the confirmation of the latter, Mr. Helme called attention to the fact that the accounts showed a net profit on the year's working of £1080 available for the borough fund. At the beginning of the year, he said they might hope to make £1000; and though they had suffered considerable loss in the demand for gas, owing to the withdrawal of certain large customers, they had had a very successful year. The receipts for gas had fallen by £165; the consumption by public lamps had been £20 less inside the borough, arising from the more general use of electricity. Outside, however, it had increased. Owing to the smaller quantity of coal carbonized, the receipts from coke had fallen by £69; and there had been a drop of £196 in residuals—the total decrease being £451. On the expenditure side, there was an increase in new mains, services, and meters, partly owing to the number of prepayment meters (nearly 400 of which had been put in during the year), of £571 14s. 6d. Rates, taxes, and water showed an increase of £331 15s. 5d. Some time ago, the wages of the stokers and labourers were raised; and the amount for the portion of a year since elapsed was about £130. Then instead of paying as last year £1174 to the sinking fund, they had paid £1601; the difference being £427. The amount spent on repairs and maintenance of works had been £896—considerably less than last year, because they had not had to erect the large retort-bench at a cost of £1291. The prepayment meters were a source of great satisfaction to small consumers and of profit to the Gas Department. They had received £597 13s. 2d. for gas sold through the 647 prepayment meters now in use; and he was glad to say that cooking-stoves were being gradually taken up in connection with these meters. About 40 had already been fixed, and they had orders for others. These were dealt with out of revenue; so that the figures must be regarded as satisfactory, considering the smaller quantity of gas sold. This was not a matter of surprise, owing to the development and prosperity of the sister department, electricity, which was in no sense antagonistic to the Gas Department in the way of competition. The Gas Committee were doing their best to work the concern satisfactorily; and they anticipated for the current year that they would be able to increase upon the £750 which was estimated as the limit of profit. He hoped they would be able to pay £1000 to the borough fund. Mr. Bowness seconded the motion; and it was carried.

On the same occasion, the accounts of the Water Department were presented. They showed that the sale of water during the year ended March 25, 1898, produced £13,634, as compared with £13,376 in the preceding twelve months; the total receipts being £15,230 against £13,572. The expenditure, including interest and redemption, being £12,012, the net profit was £3218. This was £2439 less than in the year 1896-7; but the difference was more than accounted for by the interest and redemption on the new debt, and a payment of £897 in respect of an action for polluting the River Wye. The Mayor (Alderman Huntington), in moving the confirmation of the Water Committee's minutes, remarked that in February it was estimated that the profits from the Water Department to be placed to the borough fund would be £2836; but they had improved upon this, and the actual sum handed over was £3218, or £382 more than was expected. There had been some exceptional drains upon the revenue, and they had had some expensive litigation. The cost of this had been defrayed out of the reserve fund, which was up to its full amount; and they would pay so much per year back to the fund until they had made it up again to £12,000. Alderman Towers seconded the motion; and the minutes were confirmed.

COVENTRY CORPORATION GAS-WORKS.

Committee's Annual Report.

The annual report of the Gas Committee of the Coventry Corporation will be presented at the meeting of the latter to-day. It states that after paying the gas annuities and the interest on loans, and providing the year's payments into the sinking fund and stock redemption fund, amounting together to £1755, there remains a net surplus profit of £4190. During the year, the whole of the remaining borrowing powers of the Corporation, under the Gas Purchase Act of 1884, have been exercised by the creation and issue of stock, part of the amount of £324,000 issued by the Council last October. The sum thus raised has been applied in payment of the cost of the water-gas plant, new mains, meters, &c., and in providing working capital. The total borrowing powers exercised since the acquisition of the gas undertaking by the Corporation amount to £219,438, of which £9462 has been repaid out of the sinking funds; leaving capital liabilities amounting to £209,976. Against this the Corporation have reserve and sinking funds totalling to £23,135; making the balance of liability £186,841. The Committee recommend that, of the surplus profits, £4000 be paid over to the general district fund; and the balance, £190, to the sinking fund.

ROCHDALE CORPORATION GAS AND WATER DEPARTMENTS.

Annual Reports.

The reports of the various Committees of the Rochdale Corporation for the year ending March 31 last have been circulated among the members of the Town Council. That of the Gas Committee is one which should afford much satisfaction. It states that the quantity of gas produced during the year amounted to 452,755,000 cubic feet; being an increase of 7,392,000 cubic feet over 1897, although the latter year had the advantage of six extra days which the change in the date of making up the accounts involved. This increase is entirely due to the demand for gas for purposes other than lighting. While improved burners and other devices have enabled consumers to effect considerable economies in the amount of gas required for lighting purposes, the constantly-increasing number of gas engines, fires, and cookers, has augmented the sales of gas for use in these appliances by about 17 per cent. during the current year, within the borough boundaries, although the winter was an exceptionally mild one. Outside the borough, very little progress has been made in this direction, and few persons are as yet taking advantage of the lower rate. The introduction of prepayment meters has resulted in a consumption of 2,393,400 cubic feet of gas, representing about 4900 cubic feet per meter; but as there is no charge made for the meter itself, and only a nominal one (1s.) for the cost of fixing, the increased charge of 7d. per 1000 cubic feet cannot be said to produce a very satisfactory return on the outlay. The Committee are glad to be able to report a net profit of £7821 as the result of the year's working; being £2093 in excess of the previous year. There has been some improvement in the returns from coke and sulphate of ammonia; but the prices of all tar products are extremely low. Contracts for the supply of coal for the ensuing twelve months have recently been entered into on favourable terms. During the year additional plant for the storage and distillation of tar has been provided; and new stables, now approaching completion, will set free a convenient site for further extensions of this plant as required. Careful attention has been paid to the illuminating power and purity of the gas. The average of 268 tests gave 18·19 candles as the illuminating power; and the total sulphur and ammonia present in the gas have been kept down to an average of 13·53 grains and 0·28 grain per 100 cubic feet respectively. Matters connected with the proposed supply of electricity within the borough have been constantly under the consideration of the Committee during the year. The Provisional Order authorizing the supply has been issued by the Board of Trade, and now awaits confirmation by Parliament. Contracts for the supply of the engines and dynamos have been provisionally entered into with the sanction of the Council; and the specifications for the other parts of the

plant have also been prepared, and are now under consideration prior to the application for the necessary borrowing powers. Until these are obtained, no further steps are practicable. The Water Committee report that the income from domestic supplies for the year was £26,016; being an increase of £780. The meter supplies amounted to £6160, which is an increase of £120. With the increase of water-rentals and reductions in the items of expenditure, the amount of the deficiency will be reduced from £3862 to £2466; being a decrease of £1396 for the year. To meet the constant demand for additional water, the Committee remark that it is necessary to secure additional sources of supply as proposed by the Bill now in Parliament.

ELECTRIC LIGHTING NOTES.

The Leigh District Council last Tuesday resolved to apply to the Local Government Board for permission to borrow £10,500 for the construction of electricity works.

The Ludlow Town Council last Thursday resolved to apply for an Electric Lighting Order, with the view of carrying out an installation for the borough as soon as practicable.

The Brighton Town Council last Thursday resolved to apply to the Local Government Board for sanction to the borrowing of £56,300 required for extending the machinery at the electric light station and the distribution system, and for providing new services and meters.

The Lewes Town Council seem to have abandoned all idea of entering into the electric lighting business—at all events for the present. Last Wednesday they decided to open up negotiations with a company with a view to taking over the Provisional Order; and to the General Purposes Committee was delegated the duty of treating in regard to terms.

At a meeting of the Parliamentary Committee of the Leeds Corporation last Thursday, reference was made to the Provisional Order which has been obtained in connection with the purchase by the Corporation of the undertaking of the Yorkshire House-to-House Electricity Company. The Corporation have to pay stock bringing in 5 per cent. per annum on the capital properly expended by the Company; and satisfaction was expressed that a term of forty years was allowed for the repayment of the money to be borrowed for the purpose. The Local Government Board at first proposed to allow only thirty years for repayment; but, upon further representations being made to them, they extended the term for an additional ten years.

The demand for electric current at Blackpool has more than doubled since last year. All the available plant is in use; and the Corporation have nothing to fall back upon should anything happen to the machinery. This was the essence of the evidence that Mr. R. C. Quinn, the Corporation Electrical Engineer, laid before Mr. G. W. Willcocks, who conducted an inquiry at Blackpool last Tuesday into an application for sanction to borrow £40,000 for additional electric lighting works. The manner in which the undertaking has grown was indicated by the figures supplied by the Town Clerk (Mr. T. Loftus). He said that at the end of 1892 the Corporation received sanction to a loan of £26,000; in April, 1894, another loan of £24,000 was granted; and in June, 1896, a further sum of £30,000 was allowed—making a total of £80,000 for electric-lighting plant. The £40,000 now asked for would bring the total to £120,000. There was some opposition from the Tradesmen's Association and others, on the ground that further money ought not to be spent on the electrical works before the widening of the promenade had been carried out. That the progress made by the electric light is not impeding the development of the gas undertaking, is shown by the fact that the Inspector also received evidence as to the borrowing of £880 for the purchase of land for the extension of the gas-works.

SHEFFIELD CORPORATION WATER DEPARTMENT.

Annual Financial Statement.

The General Manager of the Sheffield Corporation Water Department (Mr. W. Terry) has issued his report and statement of accounts for the year ending March 25 last. From them we gather that £11,934 was expended during the year on capital account in connection with the existing works; bringing the total to date up to £2,258,955. On the Little Don Valley works, £79,363 has been expended during the year; bringing the total outlay on the new works to £96,763. The revenue earned by the existing works amounted to £121,450. This is an increase of nearly £6000, or 5·17 per cent., over the revenue of the previous year; and it was obtained with only a small additional expenditure on maintenance and management—the amount of this item being £22,613, against £21,405. The charges against revenue for annuities and interest on Corporation stock and mortgages are, however, somewhat higher than in the preceding year; but still the net profit on the year's working—£20,111—shows an increase of £4332 over the net profit for 1896-7. From the net profit of £20,111, £6268 was set aside as the tenth annual instalment of the sinking fund for the redemption of annuities and the extinction of loan indebtedness; and, deducting this amount, there remains a surplus for the year of £13,843, which is £4285 greater than the net surplus for the previous twelve months, and consequently much higher than any surplus hitherto made since the transfer. This satisfactory result, it should be noted, has been attained notwithstanding the reduction of the charges for water from Dec. 25 last by one-half the amount of the 25 per cent. added to the water-rates owing to the bursting of the Dale Dyke reservoir in 1864. The actual amount of this remission in the first quarter during which it was made was £2755. Figures are given by Mr. Terry showing the gratifying progress that has taken place in the finances of the department since the Corporation took over the undertaking. Up to March 25, 1897, the accumulated net surplus amounted (for nine years' working under Corporation management) to only £5809; but the surplus of £13,843 remaining on the past year's working, brings up the total to £19,652. The number of houses now supplied with water by the department is 80,519—an increase of 2020 during the year. By the provisions of the Water Act of 1896, Sheffield is compelled to assist temporarily in the water supply of Rotherham and Doncaster. In the half year ended March 25, 113,941,000 gallons was supplied to those towns, bringing in £2373—about one twenty-fifth part of the income of the whole undertaking during that period.

PENZANCE WATER SUPPLY.

Suggested Gravitation Scheme.

Owing to the difficulty experienced in dry summers in maintaining an adequate service of water, the Penzance Corporation consulted Mr. J. Mansergh, M.Inst.C.E., respecting the means for augmenting the supply; and his report was read at a recent meeting of the Town Council. At the outset, Mr. Mansergh describes the present sources of supply, and says the quantity of water available is 300,000 gallons per day from the stream, *plus* 120,000 gallons from the well—together, 420,000 gallons per day—when the yield is greatest. This gradually decreases to 80,000 gallons from the stream and 70,000 gallons from the well—together, 150,000 gallons per day—during the summer months. In August last year the daily consumption was, in round figures, 375,000 gallons. There is thus need for a further supply to meet the growing wants of the district. Mr. Mansergh estimates the population dependent upon the supply as 16,000, of whom 13,000 live in Penzance itself; and he calculated that by 1948 this will have risen to 24,000 or 25,000. Provision should be made for 35 gallons per day for the larger of these two figures, or a total of 750,000 gallons per day. He does not think that a sufficient augmentation of the supply could be obtained from the present well by extending the adits; and he disapproves of the suggestion that water should be obtained from the Ding Dong tin mine and some other sources suggested. A supply which would fulfil all requirements can be obtained from the Rosemorran stream. At Resoon there is a good dam site, and a very good reservoir site, comprising 1127 acres. The stream would yield 1,124,000 gallons per day, which would allow full compensation, and leave 750,000 gallons for Penzance. The area above the dam is sparsely populated, and, after allowing for filters, there would be an effective elevation of 300 feet. The reservoir should have a capacity of 175 million gallons. The area is wholly on the granite, and Mr. Mansergh would prefer to construct a granite dam or wall; but the cost is so much in excess of an earth bank that he estimates for the latter. The bank would be 62 feet high above the bed of the stream, and its length would be about 270 yards, the depth of the foundation perhaps about 25 feet, and the top water 375 feet above Ordnance datum. The area of the reservoir when full would be about 50 acres. On the down-stream side of the bank he proposes to construct 2000 square yards of sand filter, which would deal with the ultimate quantity of 750,000 gallons per day. Such a scheme would need parliamentary sanction; and advantage would, no doubt, be taken of the application to Parliament to put the water supply under legislative authority, and to extend and define the limits. Mr. Mansergh's estimate of the cost is £74,000, which includes the bank, the filters, the mains, a fair price for the land for the reservoir, and easements for the main, as well as 15 per cent. for engineering supervision and contingencies. Though the scheme and its cost might seem a big thing for Penzance to undertake, it would, he says, be a settlement of the water supply for at least a quarter-of-a-century, and would give the town the command of a suitable watershed and an ample supply of good water. The report has been referred to the Sanitary Committee of the Corporation for consideration.

EXTENSION OF THE HIGH WYCOMBE WATER-WORKS.

An important scheme of extension in connection with the High Wycombe Water-Works, which has been in progress since September last, was brought to a successful completion on the 25th ult., when the Chairman of the Company (Mr. J. G. Peace) formally named the new engine in the presence of a large and distinguished assembly. The matter was definitely taken into consideration about twelve months ago, when the Directors received a report from their Engineer (Mr. J. Fred Wicks) containing suggestions for the extension of the mains, the provision of a high-level reservoir, and the improvement of the plant generally, at a total cost of £3803. The proposals were adopted, and the work was put in hand. At the pumping-station, a new Worthington engine has been erected by Messrs. J. Simpson and Co., capable of raising 600,000 gallons of water per day to a vertical static head of 150 feet, and from 400,000 to 500,000 gallons to a vertical head of 380 to 400 feet. Accompanying the engine is a Cornish steel boiler, capable of working at a pressure of 100 lbs. per square inch. As to the source of supply, the original bore is still utilized; but the old suction-pipes have been replaced by new ones of steel, 9 inches in diameter. An important section of the scheme was the laying of a 9-inch rising main 1¼ miles long, extending from the works to the new reservoir on the summit of Amersham Hill, about 500 feet above Ordnance datum. The reservoir, which was constructed by Mr. G. H. Gibson, consists of a substantial concrete chamber, lined with cement renderings and brickwork, with the necessary valve chambers. Composed of arching, also of brickwork, the roofing springs from T-girders, supported by a series of piers in the centre of the reservoir. This arrangement obviates the necessity of having transverse arches, and gives practically the entire internal area for storage. The reservoir measures 72 ft. by 36 ft. 6 in. by 10 ft.; and its capacity is 167,000 gallons, including the storage in the pipes. The entire work has been executed with a view to permanent stability; and, in addition, the reservoir is designed to allow for any future development on available land owned by the Company. The latest improved method of ascertaining any rise or fall in the water is used in shape of an electrical apparatus fixed in both the reservoir and the engine-house. On every inch of rise or fall in the water in the reservoir, warning is given by the sounding of a bell; and when the reservoir is either full or empty, a continuous ringing is set up. The extensions have been carried out to the plans and under the supervision of Mr. Wicks, at an outlay which only exceeds the original estimate by about £150, due in a large measure to disturbance in the iron trade. After the ceremony of naming the engine "Excelsior" had been performed, the party took luncheon at the Red Lion Hotel, when Earl Carrington proposed "Success to the High Wycombe Water-Works," to which the Chairman responded; and among the other toasts was "The Engineer and Secretary," which Mr. Wicks acknowledged.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Town Clerk of Peebles has this week issued a circular addressed to the shareholders of the Peebles Gas Company, which begins with the words "Peebles Gaslight Company (now dissolved)," and proceeds to say that he is instructed to state to the partners or proprietors of stock of the Company that the Council now and hereby offer provisionally, and on the footing of, and conditionally upon, the subsequent adoption by the burgh of the Burghs Gas Supply (Scotland) Act, 1876, and in settlement of all outstanding questions between the burgh and the Company and the partners thereof, to purchase the whole concern as at May 26, 1898. Either the Company is dissolved or it is not. If it be, there is no longer anything to purchase; and all that remains for the Town Council to do is to meet claims for damages by those who held stock in the Company, for violent and uncalled-for disturbance of their property. This would be a unique, and a not altogether satisfactory, method of fixing the price of a gas undertaking; but it would be the most probable course which would be open to the shareholders, if the Town Council insist upon the Company being actually dissolved. To determine the question of whether the Company is or is not dissolved, words are not so conclusive as deeds; and, looking at the deeds of the Town Council, I find that they, in their offer, proceed to say that the partners or proprietors of stock will be entitled to a 10 per cent. dividend for the year to May 26, 1898, and to 5 per cent. interest on their stock until the actual settlement of the transaction on Jan. 1, 1899, when the Act may have been adopted and due preparation may have been made therefor. This can only have one meaning attached to it—that the Town Council recognize that the Company is in existence, and will continue in existence until, at least, Jan. 1 next.

The Town Council had before them a report by a Committee, in which it was stated that, upon the authority of a judicial decision in England, they were advised that the registration of the Company as a limited liability concern was of no effect against the Town Council's dissolution notice. I am sceptical upon the point. It is, of course, quite open to a partner to retire from an undertaking, in terms of the co-partnery, or, in the absence of specified terms, upon reasonable conditions; and it is also open to a co-partner to bring an undertaking to an end, if it is not fulfilling its purpose, either by obtaining a winding-up order or by sequestration. But the Peebles Gas Company is not insolvent, and cannot be sequestrated. As to the likelihood of the Court granting a winding-up order, the fact that the Town Council did not apply for one shows that they knew it was out of the question to suppose they would get it. If the Court would not order the winding up of a Company, it is not likely that they would give this sanction to a compulsory breaking up at the instance of one out of many shareholders. They have repeatedly refused to allow a single shareholder to do anything which the other members of the Company considered would be inimical to the interests of the undertaking. To do anything else would be monstrous. See what a power it would place in the hands of a single individual. Company smashing would become a lucrative employment. The consequences would be too far-reaching to admit of the toleration of such a power. But, apart from legality, which is always the lowest view which should be taken, what I feel most of all is that the course which the Town Council are taking is not an honourable one. It is coercive; and, as such, it should be considered to be altogether beneath the dignity of a Town Council.

When we come to the terms offered, there must still be disappointment. They are the payment of £157 10s. for every £100 of stock, which is said to be the price last paid for stock of the Company. There is an apparent fairness about the offer which may captivate some; but it is not sufficient. The stock of the Company is stated to be £5800. The offer is thus £8700, and all expenses paid. It is not enough. The price of a business is never calculated upon the basis of what was put into it, but upon how much can be taken out of it.

There is one passage in the report to which I give my assent. That is where the Committee say that they cannot advise a purchase unless by voluntary arrangement. The undertaking would be swamped altogether by the costs of an arbitration; and therefore it is not to be thought of. As business people, however, they should be able to arrive at an arrangement; but if a voluntary purchase is to be effected, they must apply business minds to the subject, and not minds which are imbued with a spirit of confiscation.

It only remains to say further, with reference to Peebles, that the Directors of "The Peebles Gaslight Company, Limited," have to-day issued a circular to their shareholders, in which they controvert the statements in the report of the Town Council Committee, and state that they consider the position of the Company warrants them in saying that the offer of the Council is not an adequate one, and that they know a higher price can readily be obtained. In this they are right.

Having said so much about Peebles, it is with pleasure that I turn to Helensburgh, where I find that to-day the Town Council there met and agreed that they would take the necessary steps for adopting the Burghs Gas Supply Act, if the Directors of the Gas Company would give a guarantee that they would accept an offer of £29,064, subject to conditions as to taking over stocks, &c., upon a valuation by Mr. J. M'Gilchrist, of Dumbarton. The amount named is practically double the capital of the Company. On the face of it, it does not seem to be a high price; but there may be circumstances which warrant it being fixed at what it is.

If there are any who have not yet adopted means for promoting the use of gas fires and cookers, I hope the experience at Hamilton will induce them to no longer neglect this important outlet for gas. The district was pretty well saturated with stoves and fires, when, about a month ago, an exhibition of the gas appliances of Richmond and Co., Limited, and of the Cannon Hollow-Ware Company, was held in the Town Hall; and I learn that, resulting from this exhibition, there are at present 170 large cookers on order, beside innumerable small appliances which have been sold. Think what a consumption of gas this will lead to. There is a probability of a further reduction in the price of gas being proposed at the next meeting of the Council.

I do not place much reliance upon the circumstance, but it is reported from Stirling that negotiations are in progress between the Gas Company and the Corporation for an amicable adjustment of the matters in dispute between them, so as to allow the Company's Bill to pass the House of Commons Committee unopposed. The terms offered by the Corporation Committee are, however, so far below those which the Company obtained in the House of Lords, that they can scarcely accept them. At the same time, the Directors are desirous of saving expense; and they are said to be willing to take something off both the dividend and the capital proposed and allowed by the House of Lords.

The Sub-Committee on Gas-Stoves, &c., of the Glasgow Corporation, have lately been considering the question of providing additional premises as show-rooms for gas-stoves, &c., and have recommended that suitable premises, to be used as show-rooms and complaint offices, be opened by the Corporation in Pollokshaws, Govan, and Clydebank.

The income of the Glasgow Corporation Gas Commissioners goes on increasing. At the last meeting of the Sub-Committee on Finance, which was held on 25th ult., it was reported by Mr. Fleming, the Treasurer, that the collection of gas rents for the year up to date amounted to £425,487, as compared with £408,986 at the same time last year. These figures show that there was an increase in the collection amounting to £16,501, and practically one week still to go. This increase was made in the revenue, notwithstanding that the price of the gas was reduced 1d. per 1000 cubic feet in the early part of the current financial year.

The Dumfries Gas Commission on Thursday fixed their coal contracts for the year. The average cost, including haulage, is 12s. 2·41d. per ton; and the total cost, £4279. The Committee also recommended the purchase of 340 tons of oil, which, with 60 tons in stock or to deliver, makes 400 tons. The total cost of oil is £1190. For coal and oil together, the average cost, on the basis of coal, is 14s. 9d. per ton. The yield of gas is estimated at 10,000 cubic feet per ton. The Committee subsequently altered their recommendation to the effect of taking 400 tons more of Sanquhor splint and 400 tons less of Parkhead cannel. Last year the average price of the coal contracted for was 12s. 5·10d. per ton, and of the coal and oil combined 14s. 11·40d. At the meeting on Thursday, the Manager (Mr. G. Malam) reported that 138 grills had been fitted up, and that other 182 had been applied for by consumers. Bailie Currie, speaking to this subject, said that the output of gas during May showed an increase of 365,000 cubic feet over May of last year, and that this increase was almost entirely due to the use of the grills. This is another instructive lesson as to the value of a largely undeveloped side of gas supply.

No hard-and-fast rule can be laid down as to when it might be said that a man would do well to be angry; but I suppose most people will agree with me that Mr. Forbes Waddell, the Manager of the Forfar Gas-Works, was justified in losing his temper at a meeting of the Gas Corporation on Monday. The meeting was a special one, called to consider an application by Mr. Waddell to be allowed to advise the Directors of the Monifieth Gas Company in the erection of their works. Mr. Waddell had not sought the work, but had been asked by the Secretary of the Company to undertake it. Before acceptance, he consulted his Committee; and they, being divided—one man opposing the proposal—summoned a meeting of the Corporation. At this meeting, the proposal to allow Mr. Waddell to accept the appointment was very strenuously opposed by Mr. R. F. Craik, who was, for four years after Mr. Waddell went to Forfar, the Convener of the Gas Committee. It had been explained that the duties would require Mr. Waddell to visit Monifieth—about an hour's journey—once, and occasionally twice, a week. In justice to Mr. Craik, it must be said that in his first speech he took public grounds for his opposition; but a speaker having complained of his having opened old sores, Mr. Craik returned to the attack, and began to throw out insinuations that he might state something which he knew to have taken place at the gas-works. Even then, he asked that his remarks should not be reported; but Mr. Waddell advised that every word which was uttered should go in. Mr. Craik then said something about a purifier having fallen down. To Mr. Waddell's question as to who was to blame for that, Mr. Craik retorted that he was an official, and must sit down. Then Mr. Waddell insisted that it should be spoken like a man, and taunted Mr. Craik with being a great coward. More hot words passed. Mr. Craik said he would give notice of a motion for Mr. Waddell's dismissal. In the end, however, Mr. Waddell, at the request of Provost M'Dougall, withdrew the word "coward;" and he also withdrew his application to be allowed to accept the Monifieth post. There the unpleasant incident ended. Now, I would justify Mr. Waddell on two grounds. If a public man knows of anything which he considers to be going wrong in a public department, it is his duty to speak out about it; or if he thinks fit to endeavour to have the matter remedied quietly, he is a very mean man who would speak out about it afterwards. But there is this, also, that Mr. Waddell was not allowed to carry out his own plans. They were modified by the Corporation; and a manager cannot surely be held liable for anything which he is not responsible for having recommended. I take it that it was this fact which Mr. Waddell wanted spoken out like a man, and that he was exasperated at being blamed for that of which he was not guilty. Whether he should have gone the length of publicly calling Mr. Craik a coward, is another matter. There is a certain discipline which must be required by public bodies, even from their head officials; and he was well advised to withdraw the expression.

The Monifieth Gas Company has been floated for the purpose of supplying the burgh with gas; the Police Commissioners having been vetoed by the ratepayers from adopting the Burghs Gas Supply Act. The capital is £5000 in 1000 4 per cent. preference shares of £1 each, and 4000 ordinary shares of £1 each. All the shares are offered for subscription; but of the ordinary shares it is proposed to only call up 10s. upon each in the meantime.

The purchase or non-purchase of the Saltcoats Gas-Works by the Burgh Commissioners is again to the fore; and it has been the subject of newspaper correspondence. Purchase has been strongly advocated by a writer calling himself "Vacuna;" and he adduced seven reasons in support of his recommendation. They may, however, be summed up in the opening words of the fourth—viz., "that gas undertakings managed by Commissioners would serve the interests of the district better than a private Company." This dictum is contested by "An Ironmaster," who seems to know very well what he is talking about. He is not particularly struck with the management of gas-works by Commissioners as compared with Directors. The former are generally local grocers, drapers, publicans,

and bakers; and, moreover, they belong to a changing body. The latter, on the other hand, are usually successful employers of labour or educated professional men. The "Ironmaster" argues that, from the two important standpoints of efficiency and economy of management—to say nothing of the occasional "jaunts" over the country at the expense of the ratepayers, to which Commissioners are addicted—Directors are the men for the management of gas-works. He brings some grave charges against municipal officials which it may well be hoped are inapplicable to those at Saltcoats. At all events, he is strongly against the transfer of the gas-works; and he warns the electors against the specious arguments put forward in support of it. He says Saltcoats has the reputation of possessing quite model works, which are kept in the highest state of efficiency; and he advises the ratepayers to leave well alone. It will be interesting to note the effect of his advice.

The annual gas accounts of both the Perth and Dundee Corporations have been published; but these "Notes" have grown to such length, that I am afraid any comment which I may have to make upon them must be deferred till next week.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June 4.*

Sulphate of Ammonia.—The business of the week has been to some extent interfered with by the holidays. But a fair quantity of stuff has nevertheless changed hands at full prices; and the closing quotations remain at £9 5s. per ton f.o.b. Hull, and £9 7s. 6d. per ton f.o.b. Leith and Liverpool. Speculators seem again inclined to take liberties with the market for delivery a month or two ahead; but, in the face of shrinking production and absence of stocks, selling at a discount on spot prices would appear to be risky business. For delivery further ahead, there is nothing special to report. Makers adhere to their quotations, while buyers are indifferent.

Nitrate of Soda is firmer; and 7s. 7½d. per cwt. is now required for fine quality on spot.

LONDON, *June 4.*

Tar Products.—A dull market has been accentuated by the holidays. Very little new business is reported; and the general feeling of the market is towards depression. Benzols are flat; and buyers are holding aloof. Pitch is also a little weaker, though makers express some hope for better prices next season, though it is difficult to see on what ground pitch can improve in the present state of the fuel market. There is a languid inquiry for carbolic acid in the expectation of hotter weather bringing higher prices, though crystals have been sold below parity of to-day's quotation for crude. Anthracene is weak and neglected, with a tendency to lower prices.

Market values this week are: Tar, 11s. 6d. to 14s. 6d. Pitch, 21s., east coast; 18s., west coast. Benzols, nominal, 90's, 1s.; 50's, 1s. 1d. Toluol, 1s. 3d. Solvent naphtha, 1s. 2½d. Heavy naphtha, 1s. 2d. Crude, 30 per cent., naphtha, 4¾d. Creosote, 2½d. Heavy oils, 47s. 6d. Carbolic acid, 60's, 2s. 1d. Naphthalene, 50s.; salts, 30s. Anthracene, "A," 4¾d.; "B," 3½d. to 4d.

Sulphate of Ammonia is not quite so strong. Very little is being offered; and manufacturers' stocks are low. Second-hand lots have been sold at prices averaging in all positions £9 5s. to £9 7s. 6d., less 3½ per cent. The home market is rapidly finishing with the advancing season; but it will be found to have been the best that has been experienced for many years.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is just now very little to report in connection with the coal trade of this district; ordinary operations being more or less generally interrupted by the holidays. So far as can be gathered, nothing further has been definitely settled with regard to the gas coal and locomotive fuel contracts for the ensuing season. The position of collieries as to these contracts must, however, necessarily be influenced by the wages question now brought to the front by the Miners' Federation. Though it is doubtful what action the coalowners will take at their meeting to be held shortly after the holidays—many of them strongly opposing any advance being conceded, at least for the present—the evident determination of the Federation to insist on a return at no distant date of the reduction of 10 per cent. to which they submitted a couple of years back, is necessarily tending to harden up prices, with the result that representatives of collieries are showing increased firmness in holding out for advances over last year's low prices on any new contracts or renewals. The attempt that is being made by the Yorkshire coalowners to secure advanced prices on steam-coal contracts, is also likely to have some effect upon rates in this district. With regard to the general coal trade, the demand has been very small; and pits have been stopped during the greater part of the week. On business put through, however, prices have been maintained at late rates. Best Wigan Arley remains at 10s. to 10s. 6d. per ton at the pit; Pemberton four-feet and seconds Arley, 8s. 6d. to 9s.; common house coal, 7s. to 7s. 6d.; steam and forge coals, 6s. 6d. to 7s.; and engine fuel, 3s. 3d. to 3s. 6d. for common, 3s. 9d. to 4s. 3d. for medium, and 4s. 6d. to 4s. 9d. for best sorts. The shipping trade is fairly active, with steam coal fetching from 8s. 9d. up to 9s. 6d. per ton in special cases, delivered at the Garston Docks on the High Level, Liverpool.

Northern Coal Trade.—The coal trade is still active; and there is a strong demand, so that all the collieries are fully at work. Best Northumbrian steam coals are quoted at 12s. 6d. per ton f.o.b.; second qualities, about 11s. 6d.; and steam smalls, 4s. 9d. Manufacturing coals show very little alteration; but the demand is tolerably steady. In the gas coal trade, the current demand is moderate; but there is much negotiation as to the large local and metropolitan contracts. In the latter, some progress has been made—one or two having been concluded at about 7s. 6d. per ton f.o.b., and, it is said, up to 7s. 7½d. This is an advance of from 1s. to 1s. 2d. per ton on the rates that have ruled for the contracts that

GAS AND WATER COMPANIES STOCK AND SHARE LIST.

Referred to on p. 1305.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 15	10½	Alliance & Dublin 10 p. c.	23½–24½	..	4 5 9
100,000	10	,,	7½	Do. 7 p. c.	16–17	..	4 8 8
300,000	100	Jan. 3	5	Australian 5 p. c. Db.	107–109	+1	4 11 9
200,000	5	May 26	6	Bombay, Ltd.	5¼–6*	..	5 0 0
40,000	5	,,	6	Do. New, £4 paid	4½–5*	..	4 16 0
380,000	Stk.	Feb. 24	12	Brentford Consolidated	290–295	..	4 1 4
240,000	,,	,,	9	Do. New	215–220	..	4 1 10
50,000	,,	,,	5	Do. 5 p. c. Prf..	140–145	..	3 9 0
159,375	,,	Dec. 15	4	Do. 4 p. c. Db. Stk.	134–138	..	2 18 0
220,000	Stk.	Mar. 30	11½	Brighton & Hove Orig..	270–275	..	4 3 8
218,820	,,	,,	8½	Do. A. Ord. Stk.	195–200	..	4 5 0
933,500	Stk.	Feb. 24	5	Bristol, 5 p. c. max..	127–132	..	3 15 9
420,000	20	Ma . 30	11½	British	55–56	..	4 0 4
50,000	10	Mar. 11	11½	Bromley, Ord. 10 p. c.	25–27	..	4 5 2
75,000	10	,,	8½	Do. 7 p. c.	20–22	..	3 17 3
500,000	10	Apl. 29	6	Buenos Ayres (New) Ltd	8⅞–9¼	..	6 9 9
98,122	Stk.	Dec. 30	4	Do. 4 p. c. Db. Stk.	98–100	..	4 0 0
150,000	20	Mar. 11	8½	Cagliari, Ltd.	30½–31½	..	5 4 9
100,000	10	Sep. 30	7†	Cape Town & Dis., Ltd.	15–16	..	4 7 6
50,000	50	May 3	6	Do. 6 p. c. 1st Mort.	58–60	..	5 0 0
550,000	Stk.	Apl 15	13½	Commercial Old Stock	322–327	..	4 2 7
200,750	,,	,,	10½	Do. New do.	250–255	..	4 2 4
200,750	,,	Dec. 15	4½	Do. 4½ p. c. Db. dc.	150–155	..	2 18 1
800,000	Stk.	Dec. 15	12	Continental Union, Ltd.	210–220	..	5 9 1
200,000	,,	,,	9	Do. 7 p. c. Prf.	195–205	..	4 7 10
51,600	Stk	Feb. 24	14	Croydon A 10 p. c.	310–315	..	4 8 11
168,400	,,	,,	11	Do. B 7 p. c.	255–265	..	4 3 0
535,000	Stk.	Feb. 24	5½	Crystal Palace Ord. 5 p. c.	125–130	..	4 0 9
60,000	,,	,,	5	Do. 5 p. c. Prf.	142–145	..	3 9 0
486,090	10	Jan. 27	11	European, Ltd.	23¾–24½	..	4 9 9
354,060	10	,,	11	Do. £7 10s. paid	17–18	..	4 11 9
5,922,110	Stk.	Feb. 10	12½	Gaslight & Coke, A, Ord.	297–302	+5	4 4 6
100,000	,,	,,	4	Do. B, 4 p. c. max.	118–123	..	3 5 1
665,000	,,	,,	10	Do. C, D, E, 10 p. c. Prf.	300–305	..	3 5 7
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	150–155	..	3 4 6
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	220–225	..	3 6 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	195–200	..	3 10 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	300–305	..	3 5 7
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	178–183	..	3 5 7
1,061,150	,,	Dec. 15	4	Do. 4 p. c. Db. Stk.	132–135	..	2 19 3
294,850	,,	,,	4½	Do. 4½ p. c. do.	150–155	..	2 18 1
958,000	,,	,,	6	Do. 6 p. c. do.	200–205	..	2 18 6
70,000	10	May 12	8	Hongkong & China, Ltd.	13½–14½	..	5 10 4
3,800,000	Stk.	,,	10	Imperial Continental	210–215	..	4 13 0
376,400	100	Feb. 1	4	Do. 4 p. c. Dbs. Red.	98–101	..	3 19 3
473,600	Stk.	Feb. 10	3½	Do. 3½ p. c. Db. Stk. ,,	103–106	..	3 6 0
560,000	100	Apl. 1	5	Met. of Melbourne 5 p. c. Db. / 4½ p. c. Db.	110–112 / 107–109	..	4 9 3 / 4 2 7
250,000	100	,,	4½				

* Ex div.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	Dec. 15	6	Malta & Medn., Ltd.	5½–5¾	..	5 4 4
541,920	20	Nov. 11	5	Monte Video, Ltd.	14½–15½	..	6 9 0
617,946	Stk.	Feb. 24	9¾	Newc'tle & Gatesh'd Con.	235–240	..	4 1 3
252,355	Stk.	Jan. 3	3½	Do. 3½ p. c. Db. Stk.	115–120	..	2 18 4
150,000	5	May 26	8	Oriental, Ltd.	7½–8*	–¼	5 0 0
135,000	5	,,	8	Do. New, £4 10s. pd.	6¾–7*	–¼	5 2 11
15,000	5	,,	8	Do. do. 1879, £1 pd.	1½–1¾*	–¼	4 11 5
60,000	5	Mar. 11	7	Ottoman, Ltd.	4¾–5¼	..	6 13 4
500,000	100	June 1	6	People's Gas 2nd M. of Chicago Bd.	103–108*	+1	5 11 1
848,070	10	May 26	6	River Plate Ord..	9–9¼*	..	6 6 4
250,000	Stk.	Jan. 27	4	Do. 4 p. c. Db. Stk.	98–100	..	4 0 0
250,000	10	Apl. 29	10	San Paulo, Ltd.	15–16	..	6 5 0
135,000	Stk.	Mar. 30	10	Sheffield A.	242–248	..	4 0 8
209,053	,,	,,	10	Do. B.	245–248	..	4 0 8
447,427	,,	,,	10	Do. C.	245–248	..	4 0 8
5,531,250	Stk.	Feb. 24	5½	South Metrop., 4 p.c. Ord	136–139	+1	3 15 6
1,460,000	,,	Jan. 13	3	Do. 3 p. c. Db. Stk.	100–103	..	2 18 4
60,000	Stk.	Mar. 11	12	Tottenham and A.	285–295	..	4 1 4
60,000	,,	,,	9	Edmonton B.	205–215	..	4 3 9
182,380	10	Dec. 30	7	Tuscan, Ltd.	13–14	..	5 0 0
149,900	10	Jan. 3	5	Do. 5 p. c. Dbs. Red.	100–103	..	4 17 1
				WATER COMPANIES.			
746,164	Stk.	Dec. 30	10½	Chelsea, Ord.	320–330	..	3 3 8
150,000	,,	,,	5	Do. 5 p. c. Prf.	170–175	..	2 17 2
160,000	,,	,,	4½	Do. 4½ p.c. Pf. Stk., 1875	150–155	..	2 18 1
175,785	,,	Mar. 30	4½	Do. 4½ p. c. Db. Stk.	157–162	..	2 15 7
1,720,560	Stk.	Apl. 15	8	East London, Ord.	225–230	..	3 9 7
654,740	,,	Dec. 30	4½	Do. 4½ p. c. Db. Stk.	158–162	..	2 15 7
390,000	,,	,,	3	Do. 3 p. c. Db. Stk..	104–106	..	2 16 7
700,000	50	Dec. 15	7½	G'd Junct'n, 10 p. c. max.	115–120	..	3 2 6
310,000	Stk.	Mar. 30	4	Do. 4 p. c. Db. Stk.	140–145	..	2 15 2
708,000	Stk.	Feb. 10	13	Kent	358–363	..	3 11 8
160,000	,,	,,	7	Do. New, 7 p. c. max..	213–218	..	3 4 3
1,043,800	100	Dec. 30	10	Lambeth, 10 p. c. max.	295–300	..	3 6 8
406,200	100	,,	7½	Do. 7½ p. c. max..	228–233	..	3 4 4
350,000	Stk.	Mar. 30	4	Do. 4 p. c. Db. Stk.	140–145	..	2 15 2
500,000	100	Feb. 10	13	New River, New Shares	430–435	..	2 19 9
1,000,000	Stk.	Jan. 27	4	Do. 4 p. c. Db. Stk.	141–146	–1	2 14 10
902,300	Stk.	Dec. 15	6	Southw'k & V'xhall, Ord.	155–160	..	3 15 0
126,500	100	,,	6	Do. do. 7½ p. c. max.	152–157	..	3 16 5
489,200	Stk.	,,	5	Do. do. 5 p. c. Prf.	170–175	..	2 17 2
1,019,585	,,	Apl. 15	4	Do. 4 p. c. A Db. Stk.	140–143	..	2 15 11
1,155,066	Stk.	Dec. 15	10	West Middlesex	300–305	..	3 5 7
200,000	,,	,,	4½	Do. 4½ p. c. Db. Stk.	160–165	..	2 14 7
200,000	,,	Mar. 11	3	Do. 3 p. c. Db. Stk.	104–106	..	2 16 7

* Ex div.

† Next dividend will be at this rate.

are now about ending. For single cargoes of gas coal for prompt delivery, the price is now about 8s. 3d. per ton f.o.b. Gas coke is rather firmer; but the price shows no alteration.

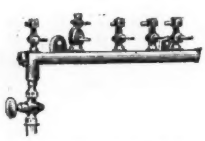
Scotch Coal Trade.—There continues to be a large volume of business; but the demand is still getting less, and prices are following. The quotations are: Main, 8s. per ton f.o.b. Glasgow; ell, 8s. 6d. to 8s. 9d.; and splint, 8s. to 8s. 6d. The shipments for the week amounted to 217,188 tons—an increase of 12,767 tons over the preceding week, and of 46,794 tons over the corresponding week of last year. For the year to date, the total shipments have been 3,403,642 tons—an increase over the same period of last year of 466,705 tons.

The Increase in the Price of Gas at Newcastle and Gateshead.—At the meeting of the Gateshead Town Council last Tuesday, the Town Improvement Committee reported that they had written to the Gas Company complaining that much dissatisfaction was expressed at the Company's proposal to increase the price of gas. The Secretary of the Company wrote in reply, and answered some questions asked by the Committee. The letter stated that the Company could not name a date limiting the period of the increased price, nor say that, after the proposed new works at St. Anthony's were put in operation, the price would be less than at present. The reasons for increasing the price were the depreciation in the value of residuals, and a probable increase in the price of coal. The price would be reduced as soon as practicable.

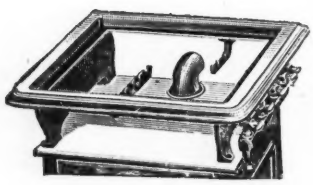
Cape Town and District Gas Company, Limited.—The eighth ordinary general meeting of this Company was held last Tuesday, at Winchester House, E.C.—Mr. J. E Lilley presiding, in the absence, through illness, of the Hon. H. Noel. In the course of his remarks, he stated that, though they had used less coal, they had made and sold more gas; and he believed that in these facts justification for the extra expenditure they had gone to in repairs and maintenance would be found. The gas made during the past year was 93,865,000 cubic feet, all of which had been sold excepting 19·27 per cent., which had gone in leakage. In the previous year, the leakage was 23·89 per cent. The sale of residuals had also increased. They had put in 281 new services, and had laid in new streets 2874 yards of mains. They had had a further increase of 9¼ per cent. in the number of meters; and the question of the advisability of employing prepayment meters in Cape Town, as in England, had engaged the Directors' serious attention, as it was thought the demand for them would be very large. They had arranged a contract—it was not signed, but he considered it as good as signed—with the Municipality of Woodstock to light a further area. In this matter they had been in competition with the electric light; but he thought the shareholders need fear nothing from this, as the contract referred to would cost the Municipality about half the amount they would have to pay for electricity, while it would give them about 50 per cent. more light. He concluded by moving the adoption of the report, and the payment of a dividend for the half year at the rate of 6 per cent. per annum (making with the interim distribution 7 per cent. for the year). The motion was carried unanimously.

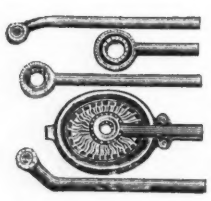
Gas Workers' Union.—The annual conference of the National Union of Gas Workers and General Labourers opened at Birmingham on Monday last week, and was continued over three days. Mr. Pete Curran presided. In his address, he spoke of the progress of the Union, which, in point of membership, was now, he said, the first organization of unskilled labourers in the country. Mr. Keegan, the President of the Birmingham Trade Council, welcomed the delegates; and Mr. Stevens, a member of the Corporation, expressed his pleasure at finding that Birmingham stood second only to London on the membership roll. The General Secretary (Mr. W. Thorne) presented the report, embracing the two years ending March, 1898. The income for this period was £29,034; and the balance brought forward, £8545, made £37,579. The expenditure (including £16,274 strike pay, and £6729 central and district office expenses) was £30,058; leaving a balance of £7521. The membership at the end of March, 1896, stood at 23,202; it is now 39,980—an increase of 16,778. The conference was occupied mainly with questions connected with the management of the Union; one matter decided being to set apart £250 per annum from the funds for the purpose of returning direct labour representatives to all public bodies. An increase in the salaries of the general officers was agreed to; and a Committee was appointed to draft a scheme for carrying on the voluntary provident department. The next conference will be held at Sunderland in 1900.

A Competing Water Scheme at Winnipeg.—A meeting of the bondholders of the Winnipeg Water-Works Company was held last Wednesday, at Winchester House, E.C., to consider the position and prospects of the undertaking, and the best course to adopt in the interests of the bondholders. The chair was occupied by Mr. G. Herring, the Chairman of the Municipal Trust Company, with which £97,300 of assenting bonds have been deposited, out of the total issue of £100,000, irrespective of preference debentures. Mr. Herring remarked that though the exclusive franchise held by the Water Company did not expire until December, 1900, the city authorities at Winnipeg had obtained an Act of the Manitoba Legislature authorizing them to commence the construction of new works at once. To grant the city such powers was a violation of the existing Company's concession, and a protest had been made to the Premier of Manitoba on behalf of the bondholders. The Municipal Trust Company had done the best they could to protect the rights of the bondholders, who, he hoped, would allow their bonds to remain deposited after the 1st prox., the date on which they were entitled to withdraw them. The following resolution was unanimously carried: "That the bondholders of the Winnipeg Water-Works Company, by whose money, amounting to £135,000, the existing works were constructed on the faith of Acts of the Provincial Government of Manitoba, hereby protest against the legislation of that Province, promoted by the Municipality of Winnipeg, whereby a competitive system of water-works is set on foot, in derogation of the concession and privileges granted by the Province to the Winnipeg Water-Works Company." A Committee was afterwards appointed, to take such steps as they might think proper in order to give effect to the protest, and secure the rights of the Company; or alternatively, to obtain due compensation for the moneys expended by the bondholders in establishing the present water supply.



DETACHABLE GAS BAR.





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Retort-House Fitting Company, Limited.—Under this title, a Company has been formed, with a capital of £6000, in £1 shares, to carry on business as gas engineers, and to manufacture and sell retort-house fittings, &c. The special object of the Company is the development and supply of the coke-conveyor devised by M. Joseph de Brouwer, of Bruges, for which they have acquired the sole monopoly for Great Britain and Ireland. This appliance, which has been fully described in the "JOURNAL," has already been introduced into several Continental gas-works, and will, it is stated, shortly be adopted in others; while inquiries are being made respecting it by gas engineers and managers in this country. The Directors are Mr. W. J. Jenkins, of Retford, Mr. J. Rice, of Sydenham, and Mr. J. Browne, the Managing-Director and Engineer. According to the prospectus, satisfactory arrangements can be made at once with a large and experienced firm of gas engineers and contractors for the manufacture of the apparatus.

Heywood Corporation Water-Works Accounts.—According to the report of the Engineer of the Heywood Corporation Water-Works (Mr. J. Diggle) for the year ending March last, there are now on the books of the department 12,984 consumers and 373 meter supplies. During the year there was an increase in the receipts for domestic supplies amounting to £345, but water sold by meter showed a reduction of £94. Rents, rates, and taxes increased by £114 through the higher assessments of the water-works in various townships. The item of sinking funds show increased instalments amounting to £523, which is attributable to the requirements of the Local Government Board consequent upon the redemption of stock. After making provision out of revenue for sinking funds, amounting in the whole to £2378, there remains a deficiency of £396 on the year's working. This deficiency would have been converted to a profit of £127 had the Local Government Board not required the increased sinking-fund contributions.

An Annual Holiday for Belfast Gas Workers.—On the motion for the adoption of the minutes of the Gas Committee at the meeting of the Belfast Corporation last Wednesday, Alderman Dempsey raised the question of an annual holiday for employees of the department. An excellent motion, he said, had been proposed in the Committee by Mr. Wilson, that the lamplighters should be allowed a week's holiday per year, without deduction of wages; but there was no seconder, and it fell through. He was surprised that the fair-minded and intelligent members of the Committee could not see their way to support the proposal. These men, who worked seven days a week, had surely as much right to a holiday as officials who were engaged for a much shorter period during only six days. He therefore formally proposed that a week's holiday be given to the employees of the Committee. From the tone of the discussion which followed, it seems that the proposition (although not so worded) was only intended to apply to the lamplighters; and it was carried by 26 votes to 11. It was succeeded by a further motion, by Alderman Sir James Haslett, that the Committee be instructed to consider if the same privilege could be extended to general gas workers. On a poll, this was also passed, by 21 votes to 15. The minutes of the Committee were adopted with these amendments.

Fire at the Globe Meter-Works.—On the evening of Saturday, the 28th ult., an outbreak of fire occurred at the Globe Meter-Works, formerly belonging to Messrs. J. & J. Braddock, but now included in the property of Meters, Limited. The conflagration originated in a place where paint and turpentine were stored; and the brigade had difficulty at the commencement in getting at the seat of the fire. After about an hour's working, however, they had it well under control. Damage to the extent of about £400 or £500 was done; but it is covered by insurance.

New Joint-Stock Companies.—The Dargue Acetylene Gas and Electrical Company has been registered with a capital of £5000 in £1 shares (of which 3000 are 5 per cent. cumulative preference shares), to adopt an agreement made with William H. Dargue, electrical engineer, of Newcastle-on-Tyne, and to carry on the business of patentees and manufacturers of acetylene gas apparatus, electricians, mechanical engineers, and suppliers of acetylene and other gas and electricity. The Hydro-Incandescent Gas-Light Company, Limited, has been formed with a capital of £200,000, in £1 shares, to adopt an agreement with M. J. Wells and S. B. Beckles to acquire certain patent rights for Great Britain, Canada, South Africa, India, and Australasia, for gas-compressing and pressure-regulating apparatus, and to carry on the business of suppliers of gas and electricity, gas apparatus manufacturers, electricians, &c.

Leigh (Lancs.) Gas and Water Supply.—The annual report of the Gas Manager of the Leigh District Council (Mr. J. Foster) shows a profit of £1748. Mr. Foster was not appointed till July last year, so that he is only responsible for the working since that date. The coal carbonized was 10,687 tons, and the quantity of gas sent out was 110,152,000 cubic feet; being an increase at the rate of 8·70 per cent. There were 4480 consumers on the books at March 31 last, as compared with 4342 at the corresponding date in 1897. The capital invested in the works is now £102,703, against £101,161 last year; and is equal to £9 12s. 4·37d. per ton of coal, &c., carbonized, 18s. 8·55d. per 1000 cubic feet of gas made, and £1 0s. 0·24d. per 1000 cubic feet sold. The sinking fund amounts to £16,973, an increase of £1714 during the year; and the reserve fund, to £5426. The gas supplied for street lighting is not charged for, or there would have been £1499 17s. 4d. more to add to the revenue account. At the meeting of the District Council last Tuesday, the following recommendations of the Gas Committee were adopted: "That £1748, being the amount of the profits of the gas-works for the year ended March 31, be placed to the credit of the district fund account; that a reduction of 3d. per 1000 cubic feet be made in the price of gas from March 31 last (3s. 3d. to 3s.); that the plans of the proposed extensions at the gas-works be approved; and that the Clerk be instructed to apply to the Local Government Board for sanction to borrow the sum of £25,000 required therefor." The report on the water undertaking showed that 36,988,500 gallons of water had been supplied by meter for trade and domestic purposes, yielding a revenue of £2740, against £2842 before; and 83,261,500 gallons to houses and for animals, yielding £4299, against £4183. The total capital outlay on March 31 last amounted to £40,006; and the year's profit was £972, against £344.

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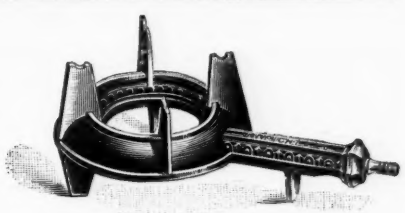

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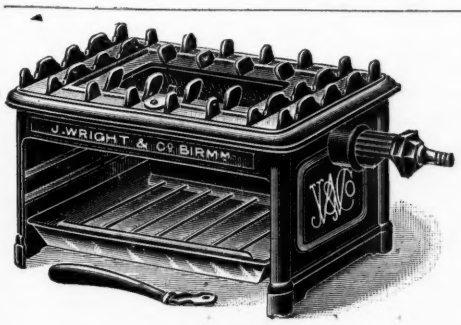

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The Award in the Nidd Water-Works Arbitration.—A few weeks ago, arbitration proceedings took place between the Hon. H. E. Butler and the Bradford Corporation regarding the amount of damages to be paid for injury done to his sporting estate at Greenhow Hill, Pateley Bridge, by the construction of the conduit from the Nidd water-works to Bradford. The Umpire (Mr. G. H. Crowther, of Huddersfield) has fixed the compensation at £405. The amount claimed was £1133.

Beccles Gas Company.—The annual general meeting of this Company was held on the 26th ult. The statement of accounts showed that the income for the past financial year amounted to £3551, and the expenditure to £2581; the profit being £970. The balance available for distribution was £2590; and the Directors recommended a dividend of 6½ per cent. on the original shares and 5½ per cent. on the later issues—making with the interim dividend of 2½ per cent. already paid, 9 per cent. on the former and 8 per cent. on the latter. This was agreed to.

Sales of Shares.—At the Dolphin Hotel, Southampton, on May 27, Mr. A. A. Burnett sold nine fully-paid £25 shares in the Southampton Gas Company at £41 10s. each. Last Tuesday, at Maldon, 225 £10 debentures in the local Gas Company, bearing interest at the rate of 4 per cent. per annum were sold at prices varying from £10 10s. to £10 12s. On the same day, Messrs. Harris and Jackson disposed of 18 original £12 10s. shares in the Abingdon Gas Company, on which a dividend of 6 per cent. was recently paid, at £15 15s. and £16 each. Messrs. Kidwell and Sons last week disposed of four £5 shares in the Brompton, Chatham, and Gillingham Water-Works Company for £16 10s. per share; this being a record price. Two other shares realized £16 5s. each. By order of the Directors, Messrs. Spelman recently sold at Norwich 250 new ordinary £10 shares in the local Water Company. The prices ranged from £19 15s. to £20, or an average of £19 19s. 5d. On the same occasion, 25 ordinary shares changed hands at £20 and £20 2s. 6d. each.

West Bromwich Gas Supply.—At the meeting of the West Bromwich Town Council last Wednesday, the Gas Committee reported that the accounts for the financial year ending March 31 had been audited and a copy forwarded to each member of the Town Council. The surplus was £4330; and they recommended that £1500 be transferred in aid of the general district rate, that £2500 be placed to the depreciation fund account in reduction of the debit balance thereof, and the balance of £330 added to the existing balance (making a total of £10,721) which was employed as working capital. Alderman Farley, in proposing the adoption of the report, pointed out that the total income from all sources was £42,760—an increase of £3808 compared with the previous year. The gross profit was practically 7 per cent. on the capital, while the net profit worked out at £4330—an increase of £1495 over the previous year. The balance on the depreciation fund now stood at £6771. As this fund had been created by the slot meters and the connections to them, it was proposed, instead of capitalizing it, to pay it off out of the revenue as soon as possible, so that the capital outlay of the undertaking might not be increased. The sum of £2500 would be transferred from that fund; thus leaving £4271 in it. The report was adopted.

Llanidloes Water Supply.—Mr. H. P. Boulnois, one of the Inspectors of the Local Government Board, recently held an inquiry at the Town Hall, Llanidloes, into an application by the Town Council for sanction to borrow money for the purpose of water supply. Replying to the Inspector, the Acting Town Clerk said the gross rateable value of the borough was £8335, and the rate was 1s. 8d. in the pound each half year. The present scheme was a competitive one, for which seventeen plans had been submitted. The original amount asked for was £12,000, £6376 of which was required for water purposes. The remainder was for sewerage work, and to pay off an outstanding loan of £5000. The Council hoped the Board would grant as long a time for repayment as possible. They wanted fifty years. The Engineer (Mr. Beasley) explained the scheme. He said it was proposed to obtain water from Nantygeifr, about 2¼ miles from Llanidloes; and the reservoir would impound 6 million gallons. The watershed was 260 acres, and the rainfall of the district was 42 inches per annum. Gaugings in the height of summer were submitted, which showed that the maximum quantity per 24 hours was 300,000, and the minimum 51,794 gallons. Evidence was also given by Dr. J. Vaughan Owen, the Medical Officer of Health, who referred to the unsatisfactory state of the sewerage owing to no water supply being connected with it, and also to the high death-rate of the borough. No one appeared to oppose the scheme except the tenant of Nantygeifr, who claimed £200 to forego his mining rights and £140 for loss of water power. The inquiry lasted three hours; and the Inspector will report in due course.

Newbury Corporation Gas Supply.—At the last meeting of the Newbury Town Council, the report and accounts of the Gas Department were presented. The income for the year ending March 31 was £7010; the expenditure, £5057—leaving £1953 as net profit. After paying interest, &c., there was a surplus of £583, which sum added to £382 brought forward made a total of £965. The quantity of gas made under the supervision of Mr. R. M. Couper, the Manager and Secretary, was 31,729,000 cubic feet, of which 29,005,300 cubic feet were accounted for. Mr. Smith, in moving the adoption of the report, said there was a small increase in the output; showing that the undertaking was progressing as reasonably as could be expected. The balance-sheet was very satisfactory, far more so than any they had had for a long time past; and it reflected great credit on the Manager. For some years there had been a hope that the price of gas would be reduced; and no doubt it ought to be cheaper, because 4s. 6d. per 1000 cubic feet, less the 4d. discount, was a large price compared with other towns. The Gas Committee now proposed to reduce it by 3d.; and with the 4d. discount allowed as usual, the price would be 3s. 11d. They felt justified in making this reduction, and also in placing £300 to the district fund, The reduction would absorb about £300. In handing over this £600. they were not courting popularity, but by reducing the price they hoped to have increased consumption and extra profits. The undertaking was acquired for the express purpose of benefiting the rates; and for a long time they were disappointed of any result. But they hoped the turning-point had now been reached, and that their ideas would be realized. He trusted that in future the gas undertaking would, as originally intended, prove of benefit to the borough. The report was adopted.

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HALIFAX	1,000,000	PETERBOROUGH, ONT.	250,000
TORONTO	250,000	WILKESBARRE, PA.	750,000
OTTAWA	250,000	ST. CATHERINES (Second Contract)	250,000
		BUFFALO, N.Y.	2,000,000
		WINNIPEG, MAN.	500,000

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Failure of the Electric Light at Brighton.—Some consternation was caused in Brighton, on the night of the 28th ult., by the electric light failing all over the town for about eight minutes. The accident occurred about half-past eight o'clock, before darkness had fully set in. In the streets, therefore, little or no trouble ensued; but in the shops, the hotels, and the places of public resort, as well as in private houses, the failure of the lights came with startling effect, and, in the shops in particular, caused considerable inconvenience. The primary cause of the breakdown was the stoppage of an exhaust-valve in one of the driving-machines, which led to the firing of one of the dynamos.

Bankruptcy of the Late Secretary of the Oswestry Gas Company.—At the Madeley Bankruptcy Court last Wednesday, before Mr. E. B. Potts, Registrar, Mr. David Askin, formerly Secretary of the Oswestry Gas Company, was examined as a bankrupt. His statement of affairs showed gross liabilities amounting to £1211; expected to rank, £1172; and a deficiency of £1117. In reply to Mr. F. Cariss (the Assistant Official Receiver), the debtor said for many years he was Secretary to the Oswestry Gas Company, and became deficient in his accounts to the extent of £700. He borrowed from his relatives from time to time to pay back the money which he missed from the safe, but which he never had for his own use. The reason he did not complain was that he feared losing his situation; and he borrowed the money to make up the deficiency in preference. He also used other moneys entrusted to him for the purpose, and, as occasion required, repaid this with money belonging to the Company; and he now owed them £158 on this account. The examination was closed.

Cockermouth Gas Supply.—At the last meeting of the Cockermouth District Council, the Gas Manager (Mr. Harold Baker) submitted his annual report. It contained two very satisfactory features—an increase in the sale of gas and a reduction of the leakage. Perhaps the most important matter, however, was the excellent results obtained by the sulphate plant. This had been working at intervals during the year, and had produced 15¼ tons, for which they received an average price of £8 3s 6d. per ton. The actual expenditure, including charges for depreciation, interest on capital, &c., amounted to £78 4s. 6d.; and the value of sulphate produced was £124 5s. 2d.—leaving a net profit of £48 0s. 8d. Mr. Stephenson congratulated the Manager on his report, and said the year's working was the most successful they had had since the Council took over the gas-works; and they had every reason to believe that the present year would be quite as satisfactory. It transpired that the Gas Committee intend, if the good general results of the past year's working are continued, to increase the reserve fund to £1000, and then reduce the price of gas. Mr. Baker's salary was advanced by £20 per annum.

Portsmouth Water Company.—The half-yearly general meeting of this Company was held on the 26th ult.—Mr. W. Grant, J.P., in the chair. In moving the adoption of the report, already noticed in the "JOURNAL" (p. 1211), he said the water-rental in the half year ending March 31 had increased by no less than £1631 as compared with the corresponding period last year. This was equivalent to £2700 in the year, and was the largest increase of revenue that had taken place in any single six months during the past eleven years. On the other hand, their expenditure had been heavy. However, the net result was that, after the payment of the full statutory dividend, there was a balance of £6335, which the Directors recommended should be carried forward, because there would be heavy drains upon the Company's revenue. They were threatened with litigation with regard to their charges; and, as custodians of a property worth more than a million of money, he was sure they would have the shareholders' unanimous approval in defending their interests to all lengths in what they considered a just cause. Colonel Owen seconded the motion; and it was carried. At an extraordinary meeting subsequently held, the Provisional Order granted by the Board of Trade to enable the Company to raise additional capital was adopted.

Staffordshire Potteries Water-Works Company.—The 52nd annual meeting of this Company was held at Hanley on May 25—Mr. J. F. Wileman presiding. The Directors reported that the water revenue for the year was £42,947, against £40,665 for the previous year. The available balance was £21,679, which, with the balance from the last account, made a total of £22,776. Out of this they recommended a dividend of 6½ per cent. per annum, free of income-tax; leaving a balance of £3601. From this, it was proposed to transfer £2000 to the contingent fund account, making the fund £12,000, and carrying forward £1601. It was stated that the demands of the district for additional water continued to steadily increase. The extension of the works at Hatton was being carried out, and making satisfactory progress. In moving the adoption of the report, the Chairman congratulated the stockholders on the continued prosperity of the concern. Things had lately been in their favour to some extent. Among other matters, they had had a very propitious winter, and a windfall in the shape of £148 per annum—an annuity which they had had to pay to a lady, and which was represented by £5043 of 3½ per cent. stock. Without wishing to be pessimistic, he did not think it advisable to estimate too highly the result of what must be considered an exceptional year's business. This might save disappointment in the future. The Directors thought stockholders should share in the prosperity of the year; and it was only an act of justice that they should receive an extra dividend at the rate of 7 per cent. per annum. The Directors wished to recommend an increase to the contingent fund of £2000. Referring to the secretaryship, he thought the stockholders would be satisfied that they had been able to obtain a Secretary of the abilities of Mr. H. J. Wildin, in succession to Mr. J. B. Piercy, who had retired. The report was adopted; and a dividend at the rate of 6½ per cent. per annum was declared. As mentioned elsewhere, it was decided to grant Mr. Piercy a retiring pension of £250.

Messrs. R. Dempster and Sons, Limited, of Elland, have obtained the contract for the construction of regenerator furnaces, &c., on Chester's principle, for the Rhondda Urban District Council, for which tenders were invited in the "JOURNAL" for the 24th ult. The drawings were prepared by the Council's Engineer and Manager, Mr. Octavius Thomas.

An interesting feature of the supply of natural gas in America is the recent inauguration of the use of gasholders on an extensive scale by the companies engaged in this enterprise. The Riter-Conley Company, of Allegheny (Pa.), have been awarded the contract for a 5 million cubic feet holder, with steel tank, for the Allegheny Heating Company; their plan being to fill the holder during the night hours of smallest consumption to help them out during their period of greatest demand.

Exhibitions of gas appliances have lately been held by the following firms: Messrs. R. & A. Main, Limited, at Haddington, Huddersfield, and North Berwick. Messrs. Fletcher, Russell, and Co., Limited, in Edinburgh. Messrs. W. Parkinson and Co. (in conjunction with Messrs. Richmond and Co. and Messrs. John Wright and Co.) at Stone, with lectures by Miss Edith Sanderson. Messrs. Richmond and Co., Limited, in Edinburgh. Messrs. John Wright and Co., Limited, at Wrexham, with lectures by Miss J. Barker.

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Newark, May 27, 1898.

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THE Directors of the above Company are prepared to receive TENDERS for the purchase of the AMMONIACAL LIQUOR produced at their Works for One Year from the 1st day of July, 1898, at per degree Twaddel (Temperature 60° Fahr). The Liquor to be not less than 5° in strength.

Terms: Cash monthly.

Further Particulars can be had on application to the undersigned, to whom sealed Tenders, marked on the outside "Tender for Liquor," are to be sent on or before the 16th day of June next.

The highest Tender will not be necessarily accepted.

F. B. FOOTTIT,
Secretary.

Newark, May 27, 1898.

LINCOLN CORPORATION.

(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee of the Lincoln Corporation invite TENDERS for the supply of 25,000 Tons of screened GAS COALS and NUTS, to be delivered during a period commencing the 1st of July, 1898, and terminating the 30th of June, 1899.

Further Particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed Tenders, addressed to the Chairman of the Gas Committee, must be delivered on or before the 25th inst.

The Committee do not bind themselves to accept the lowest or any tender.

JNO. CARTER,
Manager.

Gas Offices, Lincoln,
June 4, 1898.

LINCOLN CORPORATION.

(GAS DEPARTMENT.)

TENDERS FOR TAR.

THE Gas Committee of the Corporation of Lincoln are prepared to receive TENDERS for the purchase of the surplus TAR (about 1000 Tons) produced at their Works during the period of One Year, commencing on the 1st of July, 1898.

Sealed Tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Residuals," must be delivered at the Gas Offices, Lincoln, on or before the 25th inst.

The Committee do not bind themselves to accept the highest or any Tender.

Other Particulars may be obtained of the undersigned.

JNO. CARTER,
Manager.

Gas-Works, Lincoln,
June 4, 1898.

CORPORATION OF LANCASTER.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee are prepared to receive TENDERS for the supply of screened GAS COAL delivered on the Gas-Works Siding, Lancaster, in such quantities and at such times as may be required during a period of One Year, commencing delivery Sept. 1 next.

Sealed Tenders, endorsed "Gas Coal," giving full Particulars of the Coal offered, must be delivered to T. C. Hughes, Esq., Town Clerk, Lancaster, on or before Ten a.m., on the 21st inst.

Forms of Tender may be obtained on application to the undersigned.

The lowest or any Tender not necessarily accepted.

C. ARMITAGE,
Manager.

Gas-Works, Lancaster,
June 31, 1898.

SUTTON, SOUTHCOATES, AND DRYPOOL GAS COMPANY, INCORPORATED, HULL,

INVITE Tenders for the surplus Tar, also for the whole of the AMMONIACAL LIQUOR produced at their Works, at per Ton over the Company's Weighing-Machine, from the 1st of July, 1898, to the 31st of June, 1899, both inclusive.

Probable quantity of Tar . . . . 900 Tons.
Ditto, Ammoniacal Liquor . . . 1100 Tons.

Both Tar and Ammoniacal Liquor to be taken from the Company's elevated Tank into Contractor's Carts, which must be supplied as required by Vendors.

Tenders for Ammoniacal Liquor must state price per degree Twaddel's Hydrometer from 4° to 8°.

Further Particulars may be obtained from the Manager at the Gas-Works, St. Mark's Street.

Tenders to be sent to the undersigned on or before the 27th of June, 1898, endorsed "Tender for Tar or Liquor."

The Company do not bind themselves to accept the highest or any Tender.

DAVID WOOD,
Secretary.

Offices: St. Mark's Street, Hull,
June 3, 1898.

THE INCORPORATED

Gas Institute.

THE THIRTY-FIFTH

ANNUAL GENERAL MEETING

OF THE MEMBERS

WILL BE HELD ON

Tuesday, Wednesday, and Thursday,

the 21st, 22nd, and 23rd of June, 1898,

AT THE

EXHIBITION HALL,

BOTANIC GARDENS PARK, BELFAST.

THE CHAIR WILL BE TAKEN BY THE PRESIDENT,

JAMES STELFOX, Esq., M.Inst.C.E.

The Proceedings on Tuesday commence at 11 a.m., when a welcome will be extended by The Right Honourable the Lord Mayor of Belfast, Alderman James Henderson, M.A., J.P.

On Friday, June 24, there will be an Excursion to Rostrevor, through the Mourne Mountain District.

THE BENEVOLENT FUND.

The Annual General Meeting of the Donors and Subscribers to the Benevolent Fund will be held on Tuesday, June 21, at the close of the sitting, about 2 p.m.

WALTER T. DUNN, Secretary.

13, *Victoria Street, Westminster, S.W.*

TENDERS FOR COAL.

THE Penrith Gas Committee are prepared to receive TENDERS for COAL and CANNEL required at their Works during the Year ending June 30, 1899.

Tenders to be delivered to Mr. G. Wainwright, Public Offices, Penrith, not later than June 18.

Forms of Tender and other Particulars may be obtained on application.

E. SHAUL,
Manager.

Gas-Works, Penrith,
June 4, 1898.

GOOLE URBAN DISTRICT COUNCIL.

(GAS AND WATER DEPARTMENT.)

TENDERS FOR GAS COAL.
TENDERS FOR STEAM COAL.
TENDERS FOR AMMONIACAL LIQUOR.

COAL.

THE above Council are prepared to receive TENDERS for the supply of from 5000 to 6000 Tons of best screened GAS COAL, and 600 to 700 Tons of best screened STEAM COAL, in such quantities as the Council may direct from time to time, for One Year from date of Contract.

Gas Coal to be delivered free at the Lancashire and Yorkshire Siding in Bridge Street, the North-Eastern Railway Station, or by Boat or Compartments on the Wharf of the Aire and Calder Canal at Goole.

Steam Coal to be delivered alongside the Rawcliffe Pumping-Station, near Goole, on the same Canal.

AMMONIACAL LIQUOR.

Tenders for the surplus Liquor made during the Year from June 1, 1898, the same to be made either at a fixed price per ton, or on the Sliding-Scale regulated by the price of Sulphate.

Tenders, endorsed and sealed, to reach George England, Clerk to the Council, Exchange Buildings, Goole, before the 13th day of June next.

The Council do not bind themselves to accept any Tender.

Further Information and Form of Tender may be had, on written application only, to the undersigned.

By order of the Committee,
MATT. DUNN, M.Inst.M.E.,
Engineer and Manager.

Engineer's Office, Exchange Buildings,
Goole, May 21, 1898.

GOOLE URBAN DISTRICT COUNCIL.

(GAS AND WATER DEPARTMENT.)

GAS APPARATUS.

THE above Council are prepared to receive TENDERS for the following Apparatus:—

(1) STEEL ANNULAR CONDENSER, Eight Stacks, 25 feet high, 3 ft. 6 in. and 2 ft. 6 in. Tubes, 14-inch Valves, Connections, and Bye-Pass.
(2) ALTERATIONS and ADDITIONS to existing Retort-House.
(3) PURIFIER SIEVES, and TEE-IRON BEARERS.
(4) EXHAUSTER, ENGINE, and CONNECTIONS, and removal of present Exhauster and Engine.
(5) NEW EXHAUSTER-HOUSE.
(6) NEW WORKS OFFICES.
(7) PHOTOMETER and TESTING APPARATUS.

Tenders, endorsed and sealed, to reach George England, Clerk to the Council, Exchange Buildings, Goole, before the 13th of June next.

Further Information may be had on application to the undersigned.

By order of the Committee,
MATT. DUNN, M.Inst.M.E.,
Engineer and Manager.

Engineer's Office, Exchange Buildings,
Goole, May 21, 1898.

SCARBOROUGH GAS COMPANY.

TAR AND AMMONIACAL LIQUOR.

THE Directors of the Scarborough Gas Company invite TENDERS for the surplus TAR and the whole of the AMMONIACAL LIQUOR, to be produced at their Works for One or more Years from the 1st day of July next.

Tenders for Liquor may be submitted either at a fixed Price per Ton or on a Sliding-Scale, regulated by the price of Sulphate. Preference will, however, be given to the latter.

Further Particulars may be obtained on application to the undersigned, to whom sealed Tenders (duly endorsed) must be delivered not later than Noon, on Saturday, the 11th of June next.

The Directors do not bind themselves to accept the highest or any Tender.

By order of the Board,
(Signed) J. HOLLIDAY,
Engineer and Secretary.

Gas Offices: 32, Westborough,
Scarborough, May 18, 1898.

SHREWSBURY GASLIGHT COMPANY.

TENDERS FOR COAL.

THE Directors of the Shrewsbury Gaslight Company invite TENDERS for the supply of about 12,000 Tons of Screened GAS COAL, and about 1000 Tons of good ENGLISH CANNEL, to be delivered free at the Great Western or London and North-Western Goods Yard, Shrewsbury, during One, Two, or Three Years, commencing July 1, 1898.

The Directors reserve to themselves the right to divide the quantity into two or more Contracts, and do not bind themselves to accept the lowest or any Tender.

Tenders must be made on Forms (containing further Particulars) which may be obtained on application at the Company's Works, or by post, and must be sent to the undersigned, on or before the 17th day of June, 1898.

By order,
WM. BELTON, Assoc.M.Inst.C.E.,
Secretary and Manager.

Gas-Works, Shrewsbury,
May 18, 1898.

CRYSTAL PALACE DISTRICT GAS COMPANY.

TENDERS FOR TAR.

THE Directors of the above Company invite TENDERS for the whole or any portion of any surplus TAR—say, 1 million gallons—made at these Works during the Year from the 1st day of July next to the 30th of June, 1899. The Tar can be taken by Road or Rail from the Company's Siding.

Price to be quoted both per gallon and per ton.

Tenders to be addressed to the Chairman of the Company, and forwarded to these Offices on or before the evening of the 9th day of June next.

Conditions of Contract and any further Information may be obtained on application.

The Directors reserve the right to accept the Tender of any one or more Contractors, at their option, and do not bind themselves to accept the highest or any Tender.

By order of the Board,
CHARLES M. OHREN,
Secretary.

Offices and Works:
Lower Sydenham, London, S.E.,
May 23, 1898.

TO MANUFACTURING CHEMISTS.

TAR AND AMMONIA WATER.

THE Directors of the Loughborough Gas Company are prepared to receive TENDERS for the surplus TAR and AMMONIA WATER, to be produced at their Works for One Year, from the 30th day of June.

The estimated quantities will be about 350 Tons of Tar, and 900 Tons of Ammonia Water. The Tar and Liquor to be delivered into the Contractor's Boats at the Wharf, on the Derby Road, Loughborough.

The Strength of the Liquor to be tested by Twaddel's Hydrometer (temperature 60°); and the Tender to state the price per Ton of 4°, rising 4° up to 8°.

The Boats for the removal of the Tar and Liquor to be sent at such times as may be required.

Payments, the 10th of following month.

Further Information may be obtained on application to the undersigned, to whom Tenders, in accordance with this advertisement, must be sent not later than the 14th day of June inst.

The Directors do not bind themselves to accept the highest or any Tender.

J. B. BALL, C.E.,
Manager.

Loughborough, June 1, 1898.

COMMERCIAL GAS COMPANY.

TENDERS FOR COAL.

THE Directors are prepared to receive TENDERS for the supply of 180,000 Tons of clean, dry, unscreened, fresh-wrought GAS COALS, delivered f.o.b. to the Company's Steamers at any suitable Port, during the Year ending the 30th of June, 1899.

The deliveries to be in equal monthly quantities throughout the Year.

Payment in cash monthly.

Parties desiring to tender for more than One Year must state separately the price and quantity offered for each Year.

Particulars and Forms of Contract may be obtained from the Engineer & General Manager, Mr. H. E. Jones.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders, sealed and endorsed "Tender for Coals," to be addressed to the Chairman of the Coal Committee, and delivered at the Company's Offices not later than Ten o'clock on the 16th of June prox.

Commercial Gas-Works, Stepney, E.,
May 31, 1898.

TAR.

THE Directors of the Reading Gas Company invite TENDERS for the purchase of their surplus TAR for One Year, commencing on the 1st of July next.

Specifications for the Contract will be forwarded on application.

Rail communication direct to the Works.

Tenders, endorsed "Tender for Tar," must be delivered not later than Monday, the 13th of June, to

ARTHUR H. CANE,
Secretary.

7, King Street, Reading,
June 2, 1898.

CHESTER UNITED GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Chester United Gas Company invite TENDERS for the supply of about 19,000 Tons of Screened GAS COAL during the Twelve Months commencing the 1st of July next.

Particulars may be obtained from the undersigned, to whom Tenders, endorsed "Tender for Coal," must be delivered not later than Wednesday, the 15th day of June prox.

The Directors do not bind themselves to accept the lowest or any Tender.

JAMES PYE,
Secretary.

Gas Offices: Cuppin Street, Chester,
May 30, 1898.

BOROUGH OF BURTON-UPON-TRENT.

TAR.

THE Mayor, Aldermen, and Burgesses of the Borough of Burton-upon-Trent, acting by the Council, invite TENDERS for the purchase of the surplus TAR to be produced at their Works during Twelve Months from the end of July next.

Probable quantity of Coal carbonized during the Twelve Months, 30,000 Tons.

The Tar will be delivered free into Contractor's Tank-Trucks, on the Gas-Works Railway Siding.

Payments: Net Cash Monthly.

Tenders, sealed, and endorsed "Tender for Tar," are to be delivered to me, at or before Ten a.m., on Thursday, the 30th of June inst.

The highest or any Tender will not necessarily be accepted.

F. L. RAMSDEN,
Manager and Engineer.

Gas and Electric Light Works,
Burton-upon-Trent, June 2, 1898.

COUNTY BOROUGH OF BURY.

(GAS DEPARTMENT.)

THE Corporation of Bury are prepared to receive TENDERS for the supply for One, Two, or Three Years, of

3,000 Tons of CANNEL per annum.
30,000 Tons of GAS COAL per annum.
500 Tons of BURGY per annum.
200 Tons of HOUSE COAL per annum.

The same to be delivered in such quantities and at such times as the Gas Engineer of the Corporation may from time to time order.

Printed Forms of Tender and Conditions of Contract may be obtained on application to Mr. H. Simmonds, Engineer, Gas-Works, Bury.

Tenders, which must be on the printed forms and addressed to the Chairman of the Gas Committee, Town Clerk's Office, Bury, marked "Tender for Coal," to be delivered not later than the 17th of June, 1898.

JOHN HASLAM.

Corporation Offices, Bank Street,
Bury, May 26, 1898.

BARRY URBAN DISTRICT COUNCIL.

THE Gas and Water Committee are prepared to receive TENDERS for the supply and delivery of from 7000 to 8000 Tons of GAS COAL, and about 300 Tons of CANNEL COAL, between July 1, 1898, and June 30, 1899, in such quantities and at such times as the Engineer and Manager, Mr. F. M. Harris (of whom any further Particulars can be obtained), may require.

The person or persons whose Tender is accepted will be required to enter into a bond, with approved securities, for the due performance of the Contract.

The Committee do not bind themselves to accept the lowest or any Tender.

Sealed Tenders, endorsed "Tender for Coal" or "Cannel," as the case may be, giving the names of the Pits from which the Coal will be raised, and the price per ton of 20 cwt. delivered into the Siding at the Gas-Works, Barry, to be addressed to the Chairman of the Gas and Water Committee, Barry Urban District Council, Barry, Glamorganshire, on or before Tuesday, June 14 next.

Gas and Water Offices, Barry,
May 31, 1898.

SMETHWICK GAS-WORKS.

TENDERS FOR GAS COAL, CARBURETTING OIL, LIME, AND OXIDE OF IRON.

THE Gas Committee invite Tenders for the supply of about 20,000 Tons of GAS COAL and NUTS for delivery over the Year ending the 30th of June, 1899.

Forms of Tender may be obtained from the undersigned.

TENDERS are also required for the supply of CARBURETTING OIL, as may be required during the above-named period, delivered in Barrels at the Gas-Works, Smethwick. Also TENDERS for PURIFYING LIME and OXIDE OF IRON.

Tenders to be properly endorsed and addressed to the Chairman of the Gas Committee, and delivered to the undersigned not later than June 14 next.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
W. J. STURGES,
Secretary.

Public Buildings, Smethwick,
May 28, 1898.

LEAMINGTON PRIORS GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Leamington Priors Gas Company are prepared to receive TENDERS for the supply of the GAS COAL required by them during Twelve Months from the 1st of July next.

Particulars and Forms of Quotation may be obtained from the undersigned.

Tenders must be sent in on or before Thursday, the 23rd of June, 1898.

THOMAS BERRIDGE.

Gas Offices,
Leamington Spa.

BOROUGH OF ROCHDALE.

TO RETORT SETTERS.

THE Gas Committee of the above Corporation invite TENDERS for the LABOUR ONLY required in RE-SETTING EIGHT BEDS OF INCLINED RETORTS and in RE-BUILDING FIVE SETS OF REGENERATOR FLUES.

Plans of the Settings may be seen, and any further Particulars obtained, on application to Mr. T. Banbury Ball, the Manager, at the Gas-Works, to whom Tenders must be sent not later than noon on Wednesday, June 22, 1898.

Gas-Works, Rochdale,
June 2, 1898.

URBAN DISTRICT COUNCIL OF STOURBRIDGE.

(GAS DEPARTMENT.)

THE Gas Committee of this Council are prepared to receive TENDERS for the purchase of their surplus TAR for a period of Twelve Months commencing July 1, 1898.

Forms of Tender may be obtained on application to the Manager.

Sealed Tenders, endorsed "Tender for Tar," to be addressed to the Chairman of the Gas Committee, and delivered to the undersigned on or before Monday, June 13, 1898.

W. NORTH,
Engineer and Manager.

Gas-Works, Stourbridge,
May 31, 1898.

THE Urban District Council of Hindley are prepared to receive TENDERS for the supply of GAS COAL, CANNEL, ENGINE SLACK, and LIME required at their Gas-Works during the ensuing Twelve Months, and also for the purchase of the TAR and AMMONIACAL LIQUOR produced at their Gas-Works during the ensuing Twelve Months.

Full Particulars and Forms of Tender can be obtained on application to Mr. Wm. Dickinson, Gas and Water Manager.

Sealed Tenders, endorsed "Tender for Gas Coal, &c.," to be lodged with the undersigned not later than Monday, June 20, 1898.

By order,
STEPHEN HOLT,
Clerk to the Council.

Offices: Cross Street, Hindley,
June 1, 1898.

BROADSTAIRS GAS COMPANY.

THE Directors of the above-named Company invite TENDERS for the supply of about 3500 Tons of good screened GAS COAL per annum (for One, Two, or Three Years), delivered at Broadstairs Station, or into Carts at Broadstairs Harbour, in such quantities as the Manager may require from time to time.

Tenders to be sent in not later than Monday, July 4, 1898, addressed to the Chairman of the Company.

The Directors do not bind themselves to accept the lowest or any Tender.

Full Particulars can be obtained on application to the undersigned.

W. J. LATCHFORD,
Secretary and Manager.

Broadstairs, June 3, 1898.

MILLOM URBAN DISTRICT COUNCIL.

TENDERS are invited for the supply of from 1600 to 2000 Tons of GAS COAL at such times and in such quantities as the Council may require during Twelve Months from the 1st of July next. The Coal must be of the best quality. Full Particulars of Coal, Colliery, and Working Analysis to be given.

State Price per Ton delivered free at Millom Station, and (where applicable) at the nearest Port to Colliery or Depôt.

Sealed Tenders, on Forms (which can be had on application), endorsed "Tender for Coal," to be sent in to me not later than the 28th inst.

The Council will not be bound to accept the lowest or any Tender.

W. T. LAWRENCE,
Clerk.

Millom, June 2, 1898.

ASHFORD URBAN DISTRICT COUNCIL.

CONTRACT No. 1.

THE above Council are prepared to receive TENDERS from competent Contractors for the supply of the MATERIAL required in a BENCH OF RETORTS and the ERECTION of the same at their Gas-Works.

A Specification and Form of Tender can be obtained on or after Thursday, the 9th day of June next, from J. Creery, Esq., Clerk to the Urban District Council, Ashford, or Messrs. Stevenson and Burstal, 38, Parliament Street, Westminster, Engineers, on payment of One Guinea, which will be returned upon a *bonâ-fide* Tender being received.

Tenders are to be sent in, sealed and endorsed "Tender Contract No. 1," on or before Thursday, the 16th day of June next ensuing.

The Council do not bind themselves to accept the lowest or any Tender.

JOHN CREERY,
Clerk

NORMANTON GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of 4000 Tons of unscreened GAS COAL or double-screened GAS NUTS during Twelve Months commencing the 1st of July next.

Tenders, endorsed "Tender for Coal," must be delivered to the undersigned on or before Wednesday, the 15th inst.

The Directors do not bind themselves to accept the lowest or any Tender.

EDWIN H. HUDSON,
Secretary.

Gas Offices, Normanton,
June 4, 1898.

THE Middleton Corporation are prepared to receive TENDERS for the supply of CANNEL and GAS COAL (Unscreened and Nuts), delivered at the Middleton Railway Station in such quantities and at such times as the Gas Manager may require.

Tenders, addressed to the Chairman of the Gas Committee must be delivered at my Office on or before Wednesday, the 22nd of June, 1898, endorsed "Tender for Coal or Cannel," as the case may be.

The Corporation do not bind themselves to accept the lowest or any Tender.

Further Particulars and Form of Tender may be obtained by written application only to Mr. T. Duxbury, Gas Manager.

FREDERICK ENTWISTLE,
Town Clerk.

Town Hall, Middleton,
near Manchester, June 2, 1898.

TENDERS FOR GAS COAL.

THE Gas Committee of the Carnarvon Corporation invite TENDERS for the supply of 2500 Tons of best screened GAS COAL and 200 Tons of screened CANNEL, to be delivered free, as required, in Trucks on the Gas-Works Siding, Carnarvon, during the Twelve Months ending the 31st of August, 1899.

Sealed Tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Gas Committee, Guildhall, Carnarvon, to be delivered on or before Monday, the 20th inst.

The Committee reserve to themselves the right to divide the quantity into two or more Contracts, and do not bind themselves to accept the lowest or any Tender.

Forms of Tender and Specification may be had on application to the undersigned.

WILLIAM M. RUXTON,
Manager.

Gas Office, Carnarvon,
June 2, 1898.

LEEK URBAN DISTRICT COUNCIL.

TO TAR DISTILLERS AND OTHERS.

TENDERS are invited for the purchase of the surplus TAR produced at the Leek Gas-Works, for One, Two, or Three Years, from the 1st of July, 1898, at per ton of 2240 lbs. at such Works.

Further Particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed Tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, not later than Saturday, the 18th of June inst.

The highest or any Tender will not necessarily be accepted.

By order,
C. HENSHAW,
Clerk.

Town Hall, Leek,
June 4, 1898.

COUNTY BOROUGH OF HALIFAX.

TO ENGINEERING CONTRACTORS.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS for the supply and erection of VERTICAL CONDENSERS, with Valves and Connections relating thereto, for their Gas-Works, Section No. 3.

Specifications, Forms of Tender, and Prints may be obtained on application to Mr. Thomas Holgate, Engineer, Gas-Works, Halifax.

Tenders, endorsed "Tender for Condensers," must be sent to the undersigned before eleven o'clock a.m. on Wednesday, the 15th of June, 1898.

The person whose Tender is accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
KEIGHLEY WALTON,
Town Clerk.

TEIGNMOUTH URBAN DISTRICT COUNCIL.

GAS-WORKS.

TO CONTRACTORS.

THE Teignmouth Urban District Council are prepared to receive TENDERS for providing and laying about 1700 YARDS OF 14-INCH GAS-MAIN.

The Drawings and Form of Contract may be seen and Copies of the Specification, Bill of Quantities, and Form of Tender obtained at the Office of Mr. Chris. Jones, Engineer and Surveyor to the Council, Town Hall, Teignmouth, on depositing £1, which will be returned after the receipt of a *bonâ-fide* Tender with the Bill of Quantities fully priced out.

Sealed Tenders, addressed to me and endorsed "Gas-Main," are to be delivered at the Clerk's Office, Town Hall, Teignmouth, at or before Ten o'clock a.m. on Thursday, the 16th day of June, 1898.

The Council do not bind themselves to accept the lowest or any Tender.

W. R. HALL JORDAN,
Clerk.

Town Hall, Teignmouth, S. Devon,
May 31, 1898.

TENDERS FOR COAL.

THE Directors of the Harlow and Sawbridgeworth Gaslight and Coke Company invite TENDERS for about 1000 Tons of good GAS COAL, delivered at Harlow Station free, in quantities of not less than 50 Tons.

No Forms.

Tenders, addressed to the Secretary, Gas Company, Harlow, to be sent in on or before Tuesday, June 28, 1898, and to be sealed and endorsed "Tender for Coal."

FENTON URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the purchase of the surplus TAR and the whole of the AMMONIACAL LIQUOR to be produced at their Works for One or more Years from the 1st of July next.

Further Particulars may be obtained from the Manager.

Tenders to be addressed to the Chairman, Gas-Works, Fenton, and forwarded on or before Monday, the 20th inst.

F. H. DARWIN,
Manager and Secretary.

Gas Offices, Fenton,
June 3, 1898.

ROCHESTER, CHATHAM, AND STROOD GASLIGHT COMPANY.

TAR.

THE Directors are prepared to receive TENDERS for the purchase of the surplus TAR to be produced at their Works at Rochester and Gillingham for One Year, commencing July 1 next.

The quantity will be about 300,000 Gallons.

Further Particulars, with Form of Tender and Contract, may be had on application.

Sealed Tenders, endorsed "Tar," must be delivered addressed to me at these Offices, not later than noon of Thursday, June 16, 1898.

The Directors do not undertake to accept any Tender; and security for due fulfilment of the Contract must be given if required.

J. M. VEEVERS,
Engineer and General Manager.

Gas Offices: 95, High Street,
Rochester, June 2, 1898.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to DEBENTURE STOCKS and BONDS, WILL BE CLOSED at Four o'clock p.m., on Friday, the 10th inst., for the Half Year ending on the 30th inst., and will be RE-OPENED on the morning of Saturday, the 11th inst.

The Interest for the Half Year will be payable on the 1st of July next to the Proprietors registered on the closing of the Books.

By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., June 1, 1898.

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

SALE OF £50,000 FOUR PER CENT. DEBENTURE STOCK.

THE Directors of the above Company give Notice that they will be prepared to receive TENDERS for the above STOCK in sums not less than £25 or multiples thereof.

Printed Tender Forms and Particulars of Conditions of Sale, with all other Information necessary, can be had on application to the Secretary of the Company, at the Company's Offices, D'Olier Street, Dublin, or will be forwarded to any part of the country on application.

Tenders must be delivered at the Company's Offices, D'Olier Street, on or before Thursday, the 30th inst.

By order,
W. F. COTTON,
Secretary and Manager.

Board Room, D'Olier Street,
Dublin, June 1, 1898.

Price 7s. 6d., Demy 4to., Limp Cloth.

THE FLOW OF GASES

AND PROPORTIONING GAS-MAINS

FOUR DIAGRAMS

(WITH EXPLANATORY PAMPHLET)

Invented by F. S. CRIPPS, Assoc.M.Inst.C.E.

Price 15s., Limp Cloth, the

SEVENTEENTH YEARLY

ANALYSIS OF THE ACCOUNTS

OF THE

METROPOLITAN WATER COMPANIES.

Compiled and arranged by

ALFRED LASS, F.C.A.

LONDON:
WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

EAST LONDON WATER-WORKS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS in respect both to the Four-and-a-Half Per Cent. and Three Per Cent. DEBENTURE STOCKS WILL BE CLOSED from the 15th of June to the 30th of June inclusive, and RE-OPEN on the 1st of July.

By order,
I. A. CROOKENDEN,
Secretary.

St. Helen's Place, Bishopsgate, E.C.,
June 3, 1898.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

BRENTFORD GAS COMPANY.

£15,000 OF NEW STOCK 1881.

Ranking for a Standard Dividend of 7 per cent. per annum subject to the Sliding-Scale; the last Dividend on similar Stock having been at the rate of 9 per cent.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Monday, July 18, at Two o'clock precisely, in Lots.

Particulars may be obtained of the SECRETARY of the Company, at the Offices, BRENTFORD; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

CRYSTAL PALACE DISTRICT GAS COMPANY.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Wednesday, June 29, at Two o'clock, in Lots.

£20,000 FIVE PER CENT. PERPETUAL DEBENTURE STOCK

OF THE

CRYSTAL PALACE DISTRICT GAS COMPANY,

To be created under the Provisions of the Crystal Palace District Gas Act, 1893.

Particulars at the COMPANY'S OFFICES, LOWER SYDENHAM, and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

BRIGHTON AND HOVE GENERAL GAS COMPANY.

£7500 STOCK.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Monday, June 20, at Two o'clock precisely, in Lots,

£7500 OF "A" ORDINARY STOCK OF THE BRIGHTON AND HOVE GENERAL GAS COMPANY,

Ranking for a Standard Dividend of 7 per cent. subject to the Sliding-Scale; the last Dividend on similar Stock having been 8½ per cent.

Particulars of the SECRETARY of the Company, at No. 5, GREAT WINCHESTER STREET, E.C., and 77, West Street, BRIGHTON, and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

COLNEY HATCH GAS COMPANY.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Monday, June 20, at Two o'clock, in Lots.

£3000 OF ADDITIONAL STOCK

OF THE

COLNEY HATCH GAS COMPANY,

Ranking for a Maximum Dividend of 7 per cent. per annum; the last Dividend on the Company's 7 per cent. Capital having been at this rate.

Particulars of the SECRETARY, at the Company's Offices, 5 & 6, GREAT WINCHESTER STREET, E.C.; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

GUILDFORD GASLIGHT AND COKE COMPANY.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, E.C., on Monday, July 4, at Two o'clock.

£5000 of ORDINARY STOCK

IN THE

GUILDFORD GASLIGHT & COKE COMPANY,

Ranking for a Standard Dividend of 5 per cent.; the last Dividend on similar Stock having been at this rate.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

WHITCHURCH AND DISTRICT (HANTS) GAS COMPANY LIMITED.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Monday, July 4, at Two o'clock.

150 £10 FULLY-PAID ORDINARY SHARES

IN THE

ABOVE UNDERTAKING.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

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CANDLE SAFETY LAMPS

Are a great improvement on Oil, giving a good Light, requiring little or no Cleaning, and when once lighted no further attention is necessary. The Candles are made to burn 5, 7, or 9 hours.

48, MANCHESTER STREET, GRAY'S INN ROAD, W.C.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to

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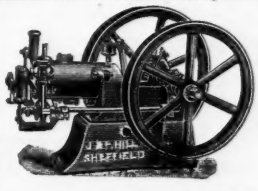
HILL'S IMPROVED

"OTTO" TYPE GAS-ENGINES

½ H.P. to 20 H.P. Specially designed for Users of Small Power.

GAS-ENGINES & DYNAMOS complete for HOTEL, HOUSE, and SHOP Installations.



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High-Class Workmanship.

J. & P. HILL,
Backfields & Norfolk Iron-Works,
SHEFFIELD.

HOLMSIDE

GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . . 11,205 Cubic Feet.
Illuminating Power 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. per Ton.
Sulphur . . . . . A little over 1 per Cent.
Ash . . . . . Under 1 per Cent.
Tar . . . . . 163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor 103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

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PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

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HOLMSIDE & SOUTH MOOR OFFICES,

NEWCASTLE-UPON-TYNE.

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Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
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DALKEITH, N.B.

BOLDON GAS COALS.

ANALYSIS.

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

For Prices, &c., apply to

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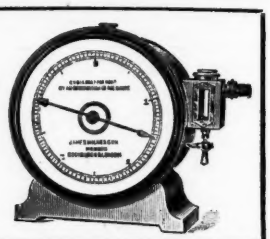

MEETING OF THE

INSTITUTION OF GAS ENGINEERS.

MEMBERS AND VISITORS PRESENT AT THE ABOVE MEETING ARE INVITED TO INSPECT THE

DENAYROUZE & BANDSEPT BURNERS

AT THE OFFICES OF THE

DENAYROUZE LIGHT SYNDICATE, LTD.

(who were the Pioneers of Incandescent Lighting WITHOUT CHIMNEYS),

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REGENERATIVE RETORT-SETTINGS.

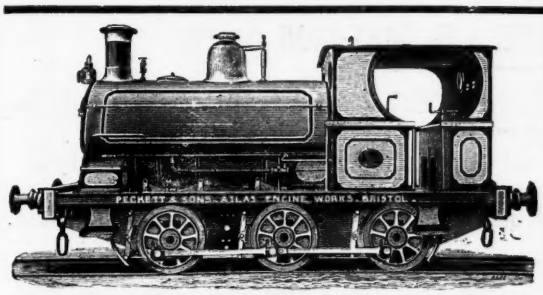
J. FIRTH BLAKELEY & CO., GAS ENGINEERS AND CONTRACTORS, RAVENSTHORPE, YORKS,

Have made arrangements with **Mr. ALEXANDER YUILL**, of Alloa, N.B., for the **SOLE RIGHT** of **BUILDING** his **REGENERATIVE FURNACES** and **SETTINGS OF RETORTS.**

By Mr. Yuill's Principle, **the maximum quantity of Gas** per Retort per diem may be obtained with the **minimum amount of fuel.**

Gas Managers who are desirous of improving their Settings should ask for Particulars and Prices **before adopting any other principle.** They give the **best results, are reliable,** and **economical in construction.**

GAS APPARATUS OF ALL KINDS SUPPLIED.



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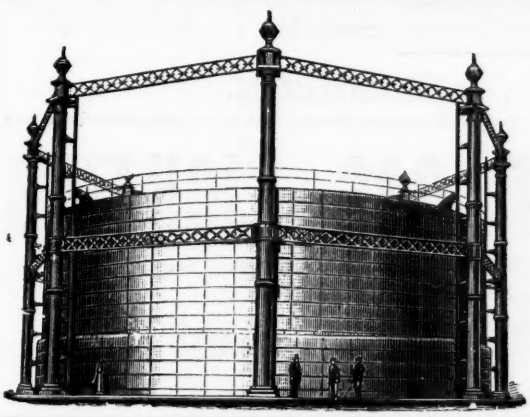

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ADOPTED AT

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IT IS STRONG AND CHEAP, AND REQUIRES NO PIERS FOR ITS SUPPORT.

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IN CAST-IRON AND TIN CASES OF THE HIGHEST EXCELLENCE.

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Results of Tests of Dry Gas-Meters (Section III.) of the Glasgow Philosophical Society's Gas Exhibition, as per London "Gas Journal," May 10, 1881.

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Total of Fast Tests . .	47·2 ..	6·9 ..	33·6 ..	62·3 ..	53·7
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CLAY'S PATENT SHOCK-PROOF FITTINGS,

which are the next best thing to UNBREAKABLE MANTLES.

The Illustrations show two of our arrangements; but we are able to cope with all conceivable conditions or requirements.

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WARNING: As we hold the Master Patents covering the COILING OF SUPPLY-PIPES to obtain a resilient bearing to neutralize the damaging effect of Shock or Vibration on the Mantles of Incandescent Burners, we shall not hesitate to immediately INSTITUTE PROCEEDINGS AGAINST ANYONE INFRINGING OUR RIGHTS.

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Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.

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EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.

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By R. O. PATERSON, C.E.

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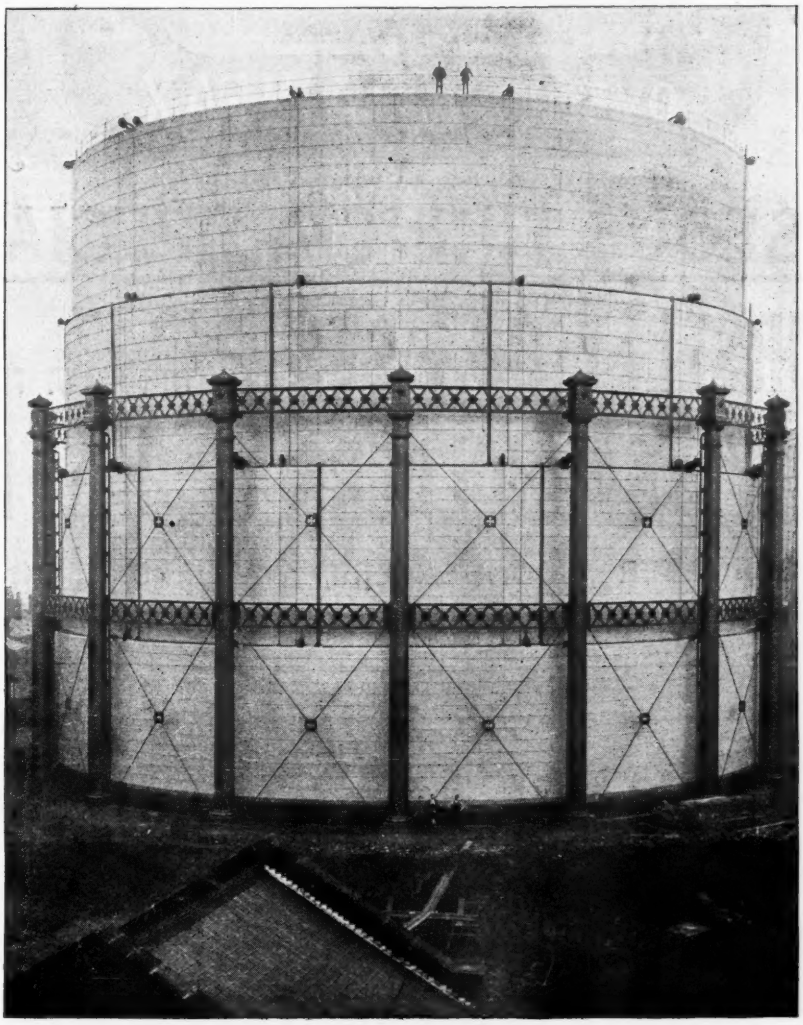

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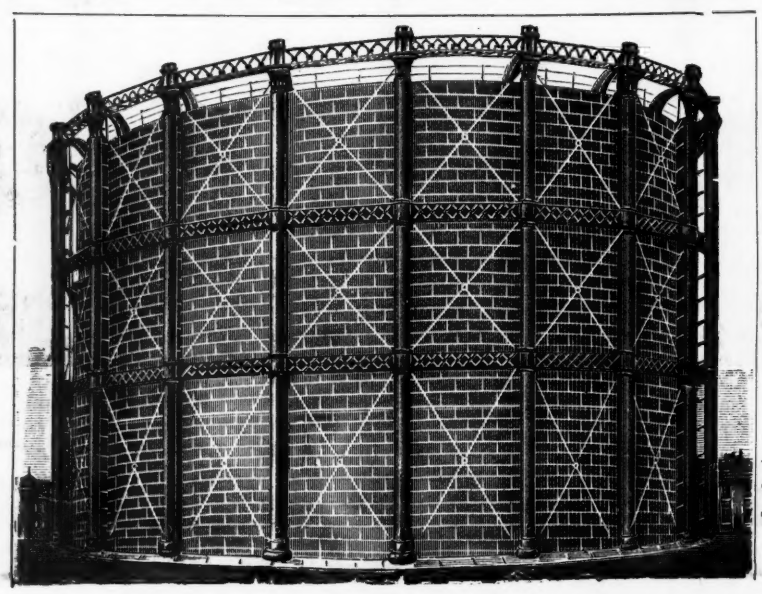

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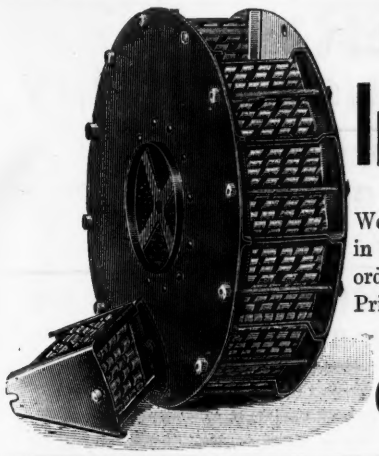

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Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

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3. Uniformity in thickness, ensuring equal Expansion and Contraction.

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MACHINE-MADE GAS-RETORTS.

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Gas Bags for Mains, High Water-Boots, Miners' Woollen Jackets, Delivery and Suction Hose, Leather Machine Bands, Diving and Wading Dresses, Waterproof Coats and Capes of every description, Iron Wheels and Rollers covered with India-rubber, Rubber Bags for Testing Drains. Stokers' Mitts, from 14s. per dozen.

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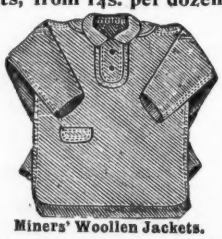

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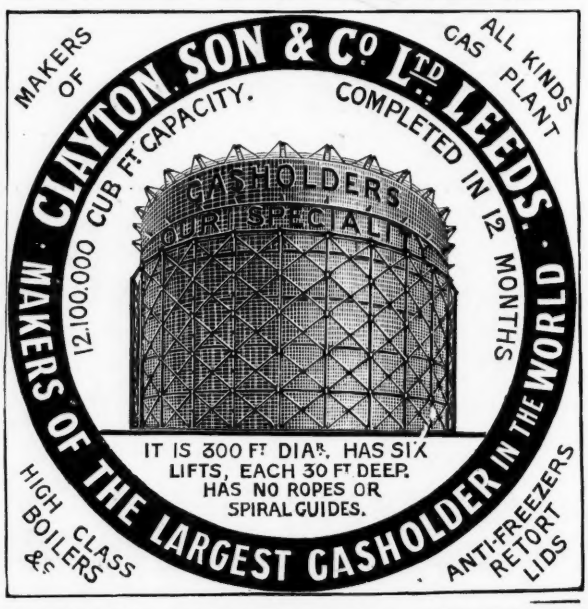
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Analysis 12,600 Feet of 19-Candle Gas per Ton.

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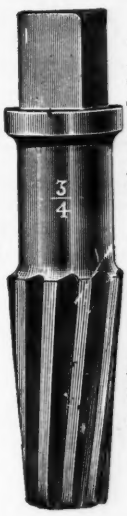

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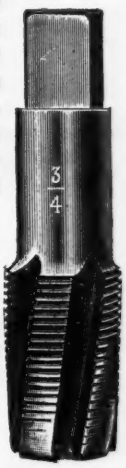

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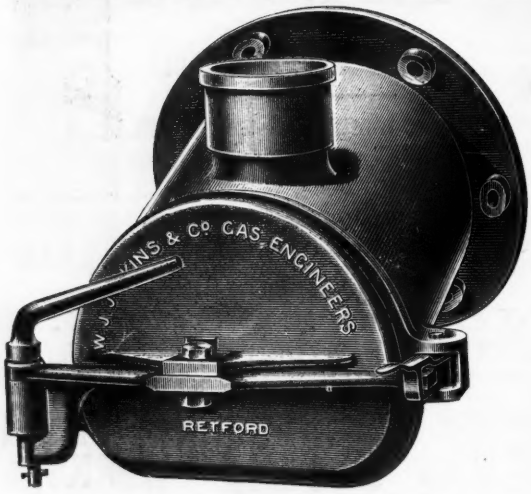

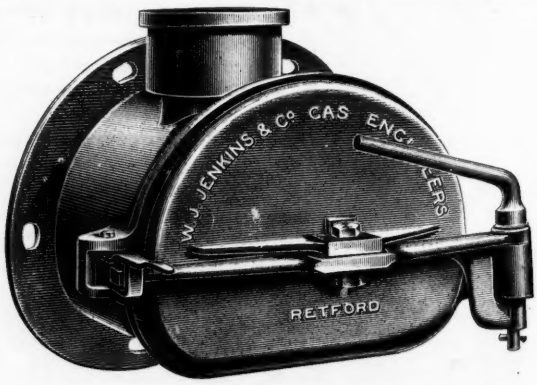

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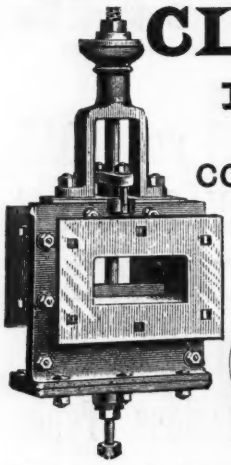

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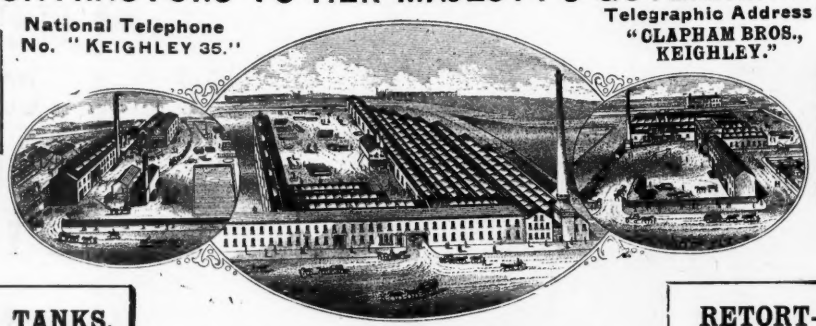

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